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DRAFT
BIOLOGICAL QUALITY OF FOUR
URBAN CREEKS,
WINNIPEG, MANITOBA, CANADA,
1997 AND 1998

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Manitoba
Conservation



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**Draft Biological Quality of Four Urban Creeks, Winnipeg, Manitoba, Canada,
1997 and 1998**

Summary

In 1995 a program was initiated by Manitoba Conservation (formerly Manitoba Environment) using rapid bioassessment techniques to assess assemblages of macroinvertebrates. The intent of this program is to provide a biological assessment tool to supplement assessments of water quality based on water chemistry alone. This report examines macroinvertebrate data collected in four urban streams. During the early 1990s, the emphasis was put on the chemical, physical, and bacteriological quality of water in Bunns, Omands, Sturgeon, and Truro creeks. During 1997 and 1998 supplemental sampling was conducted in order to examine the relative health of macroinvertebrate communities in these creeks. The macroinvertebrates were collected with kick-nets using rapid bioassessment protocols. Biological condition indices were derived using the combined evaluations of eight other macroinvertebrate assessment indices.

Macroinvertebrate communities in Bunns and Sturgeon creeks were moderately to slightly impaired in September 1998. Omands Creek macroinvertebrate communities at the upstream and downstream sites were generally moderately impaired with some severe impairment indicated in the mid-section of the creek. In Truro Creek macroinvertebrate communities from two sites appeared to be severely impaired.

Opportunity for Review and Request for Comments

Comments on the conclusions, the bioassessment process used, and the relationship of biotic indices to water quality indices should help to refine the way Manitoba Conservation collects and assesses macroinvertebrate assemblages. Please forward comments by January 31, 2001 to the following:

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DRAFT BIOLOGICAL QUALITY OF FOUR URBAN CREEKS, WINNIPEG, MANITOBA, CANADA, 1997 AND 1998

Introduction

During the early 1990s Manitoba Conservation (formerly Manitoba Environment) and a number of local citizens groups became involved in co-operative sampling programs on streams within the City of Winnipeg. Initially, the emphasis was put on the chemical, physical, and bacteriological quality of water in Bunns, Omands, Sturgeon, and Truro creeks. During 1997 and 1998 supplemental sampling was conducted in order to examine the relative health of macroinvertebrate communities in these creeks. Although the biota in streams are affected by environmental factors other than water chemistry it appears that this is a good method for determining the relative effects of overall environmental stress on biotic communities. Many anthropogenic effects are likely to be in evidence within urban streams including modification of habitat such as addition or removal of substrate, removal of riparian vegetation, and stream channelization. However, if sites are examined over a period of several years, the general trend of biotic condition will tend to reflect the impact of chemical and physical water quality.

Methods

Bioassessment Sampling Protocols

The sites selected had to be shallow enough so that the streams could be sampled using a kick net and chest waders. Preferable sites were those where it was possible to wade across the entire stream width.

Equipment used to collect the samples included a kick net with a triangular frame with a bottom width of 0.3048 m (1 ft) and an anchor with a 3.28 m length of rope. The nylon netting used in the kicknet bag had a small aperture size (800 by 900 μm). The anchor and rope were used to tether the kicknet. The person sampling backed upstream, kicking up material from the surface of the substrate into the kicknet, starting at the anchor and backing up to the end of the tether, covering a 1 m^2 area for each sample. As much of the fine material such as muck and silt was washed from the samples by agitating the bottom of the netting in the stream water. Using clean water, each sample was washed from the net into a white plastic tray. The bottom surface area of the trays was approximately 540 cm^2 or larger with a wall height of at least 5 cm. Sampling protocol varied from Hughes (2001) since only single samples were collected from each site on any one date rather than pooling five 1 m^2 samples. Macroinvertebrates were sorted in the field from the trays by eye (without the use of a microscope), using forceps, and preserved in 70% ethyl alcohol, with each sample being placed in a separately labelled jar.

Macroinvertebrate Identification

All samples were subsequently submitted to Enviro-Test Laboratories for identification of organisms to genus and species where possible. Several specimens were submitted for verification of identification to a subcontractor (Ms. L. Ross).

Macroinvertebrate Analyses Protocols

Kicknets were used to collect macroinvertebrate assemblages. Volunteers conducted this work in a similar manner to that described by Hughes (2001). The data was analyzed using the modified rapid bioassessment protocols used by Hughes to examine the relative biotic condition of macroinvertebrate communities in 27 southern Manitoba streams.

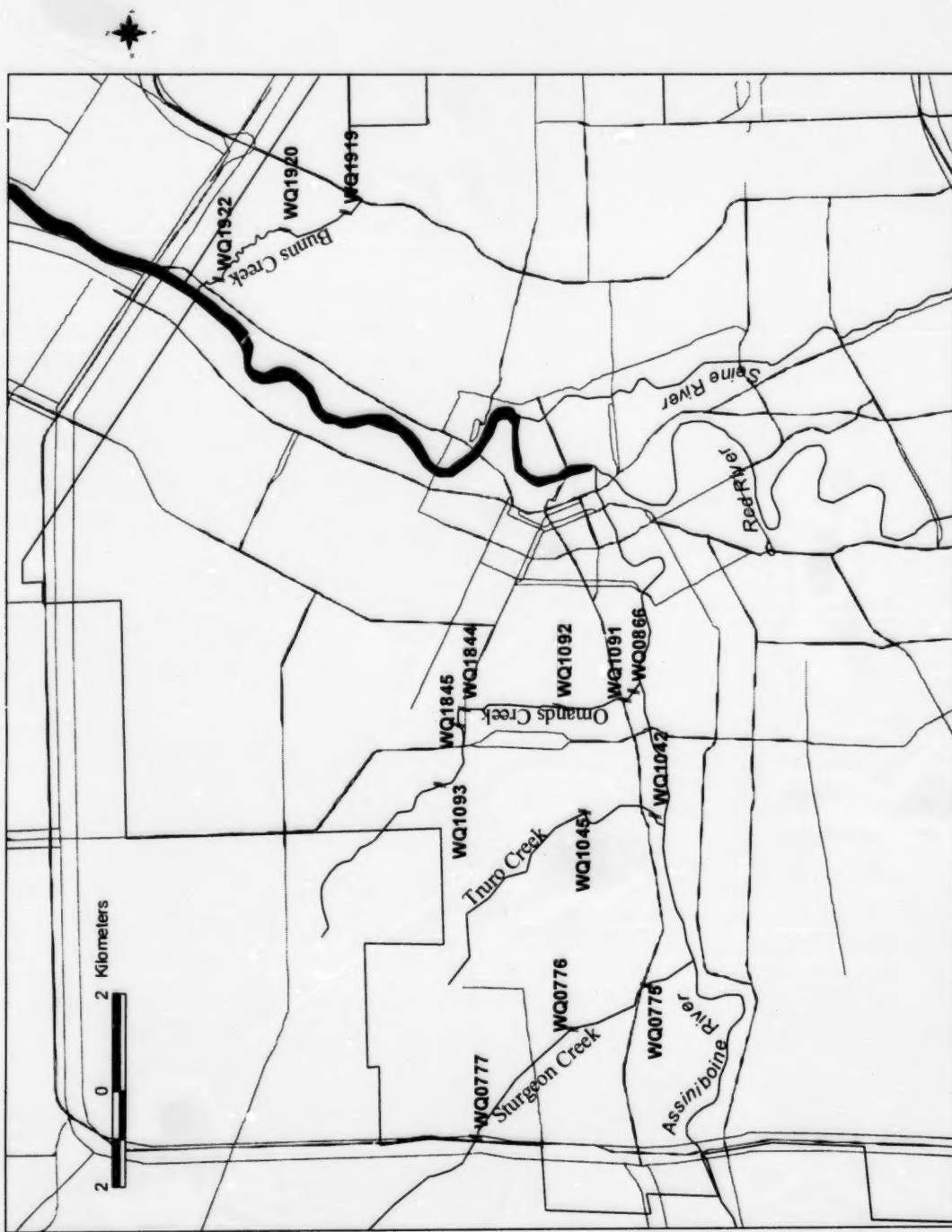


Figure 1. Urban creeks macro-invertebrate sampling sites, 1997 and 1998.

Each sample, collected from each site, on any one date was used on a stand-alone basis. On a few occasions, there were less than 100 organisms per sample, which is the least number of organisms recommended for data analysis with rapid bioassessment techniques (Plafkin *et al.* 1989). Further analyses were carried out using the bioassessment approach advocated for Rapid Bioassessment Protocol III (Plafkin *et al.* 1989).

Where possible, each taxon was assigned tolerance values and functional feeding groups in order to derive metrics required for bioassessment as described in (Plafkin *et al.* 1989). Tolerance values for use with Modified Hilsenhoff Biotic Index or HBI (Hilsenhoff 1987) as well as functional feeding groups were identified using the U.S. Environmental Protection Agency computer program Macroinvertebrate Species List, Version 1 (May, 1994). Additional information on feeding groups was also obtained from Merritt and Cummins (1984). In addition to the metrics required for bioassessment as described in Plafkin *et al.* (1989), each taxon was assigned tolerance quotients required to derive a biotic condition index (BCI) from Winget and Mangum (1979). The BCI compares organism tolerance to physical and chemical instream conditions and is a useful addition to other metrics (Plotnikoff 1994).

There are eight metrics used in this assessment and they are described as follows (Hughes 2001):

1. Taxa Richness is a count of the total number of taxa and reflects the health of the community through measurement of the variety of taxa (Plafkin *et al.* 1989).
2. Percent Contribution of Dominant Taxon is a reflection of community balance and compares the number of organisms in the dominant taxon to the total number of organisms in the sample (Plafkin *et al.* 1989).
3. The Ephemeroptera, Plecoptera, and Trichoptera (EPT) Index is a count of the number of taxa within this environmentally sensitive group of organisms. The EPT index generally increases with improving water quality (Plafkin *et al.* 1989).
4. The EPT/C Ratio is a ratio of EPT and Chironomidae abundances, which compares the number of organisms within the EPT group to numbers of Chironomidae. Chironomidae or midges are relatively tolerant organisms. This index is also a reflection of community balance (Plafkin *et al.* 1989).
5. The Community Loss Index compares the total number of taxa present in both a reference sample (a) and the sample of comparison (b) relative to taxa in common (c). The Community Loss Index = $(a-c)/b$ (Courtemanch and Davies 1987). The reference sample used in this case was a database mean pooled sample (Plafkin *et al.* 1989). The mean numbers of organisms per sample from the urban creeks were equivalent to the mean numbers of organisms in a pool of five samples collected on each occasion from the rural streams (Hughes 2001). Therefore it was assumed for the purposes of this report that the distribution of taxa were similar.
6. The Modified Hilsenhoff Biotic Index or HBI (Hilsenhoff 1987) is the mean of the sum of tolerance values ranging from 0 to 10, where the values increase as water quality deteriorates (Plafkin *et al.* 1989). The tolerance values used were New York Department of Environmental Conservation (NYDEC), Hilsenhoff tolerance values, or alternately, US Environmental Protection Agency (EPA) tolerance values were identified using US EPA Macroinvertebrate Species List, Version 1 (May, 1994). However, tolerance values were not available for some species, mainly within the Order Hemiptera.
7. The Biotic Condition Index or BCI (Winget and Mangum 1979) is derived in three stages. First, the mean Community Tolerance Quotient (CTQa) is calculated and is the mean of the sum of organism tolerance quotients, which range from 0 to 108, where the values increase as water quality declines. Second, stage the predicted Community Tolerance Quotient (CTQp) is derived using a key that reflects stream gradient, substrate type, total alkalinity, and sulphate. For the purpose of this calculation all stream gradients were estimated to be less than the ratio of 1.2%. Third, stage is the BCI is calculated

where $BCI = 100(CTQp/CTQa)$. Since this metric entails both biotic and physical and chemical characteristics of the site, it is particularly site and time specific in nature.

8. The Ratio of Shredders/Total is the ratio of the number of organisms belonging to the shredder functional feeding group to the total number of organisms in the sample. Shredders are sensitive to riparian zone impacts (Plafkin *et al.* 1989).

After the various metrics were calculated for each site and sampling date, the biological condition was then evaluated with scoring criteria as described in the bioassessment flow chart (Figure 2). The treatment of each metric is similar to that utilized by Plafkin *et al.* (1989). The Biotic Condition Index or BCI was an additional metric that was scored as a modification of the BCI assessment used by Winget and Mangum (1979). The derivation of the biological scores (Figure 2) rates the best score at 6 and the poorest score at 0. While some site metrics were treated as stand-alone values, others were compared as a ratio of reference conditions (Figure 2). Where a reference site was required, the North Duck River at PTH 10 at Cowan (Hughes 2000) should have had the least impact from anthropogenic activities since it is located on the eastern edge of the Duck Mountain forested area. The best scores from the years 1995 through 1998 at the North Duck River site were used as a reference for comparison with the Taxa Richness (29), EPT Index (10), EPT/C Index (1200%), and modified Hilsenhoff Biotic Index (HBI) (4.46) (Hughes 2001). However, the Shredders/Total ratio at the North Duck River site was considerably lower than average. Therefore, the Shredders/Total ratio was compared to a reference derived from a mean of all macroinvertebrate data from the 27 rural streams from 1995 through 1998 (14%) (Hughes 2001).

The final step in the bioassessment process is described in the bioassessment box of the flow chart (Figure 2). The mean score for each of 29 urban creek samples were compared as a ratio to a mean score (4.25) of the best site scores at each of 28 sites, in rural streams from 1995 through 1998. The degree of impairment was described as non-impaired, slightly impaired, moderately impaired, or severely impaired.

Results and Discussion

Macroinvertebrates

Macroinvertebrate indices for each sample collected from Bunns, Omands, Sturgeon, and Truro creeks are summarized in Table 1. The urban creeks were relatively productive and the mean number of organisms per sample of 625 for these creeks (Table 1) was virtually equivalent to the mean number of 646 organisms in each pool of five samples from rural streams (Hughes 2001). Numbers of organisms collected per taxa per sample from the urban creeks are shown in Appendix 1. Tolerance values, tolerance quotients, and feeding group designations for taxa collected from the urban creeks are shown in Appendix 2. Appendix 3 shows the mean reference sample for the entire 1995 through 1998 rural stream database, which was used for community loss calculations (Courtemanch and Davies 1987). The reference sample in this case was the pooled sample including 83 taxa. Appendix 4 includes the mean total alkalinity and sulphate for each site during each sampling year required for the estimation of the Predicted Community Tolerance Quotient or CTQp (Winget and Mangum 1979). In some cases total alkalinity was estimated from a previous year or from data from the next closest site. The modified Winget and Mangum key for estimating CTQp is also shown in Appendix 4, where the stream gradient was always less than 1.2%, and the substrate type was either gravel and rubble or a combination of all substrates including sand and finer substrate. Within Winnipeg, the substrates were assumed to be the latter since they were likely to include silt, muck, and clay as well as boulder, rubble, or gravel. Table 2 summarizes the final outcome of the assessment process as described in Figure 2 with evaluated biological condition categories for each site and year sampled.

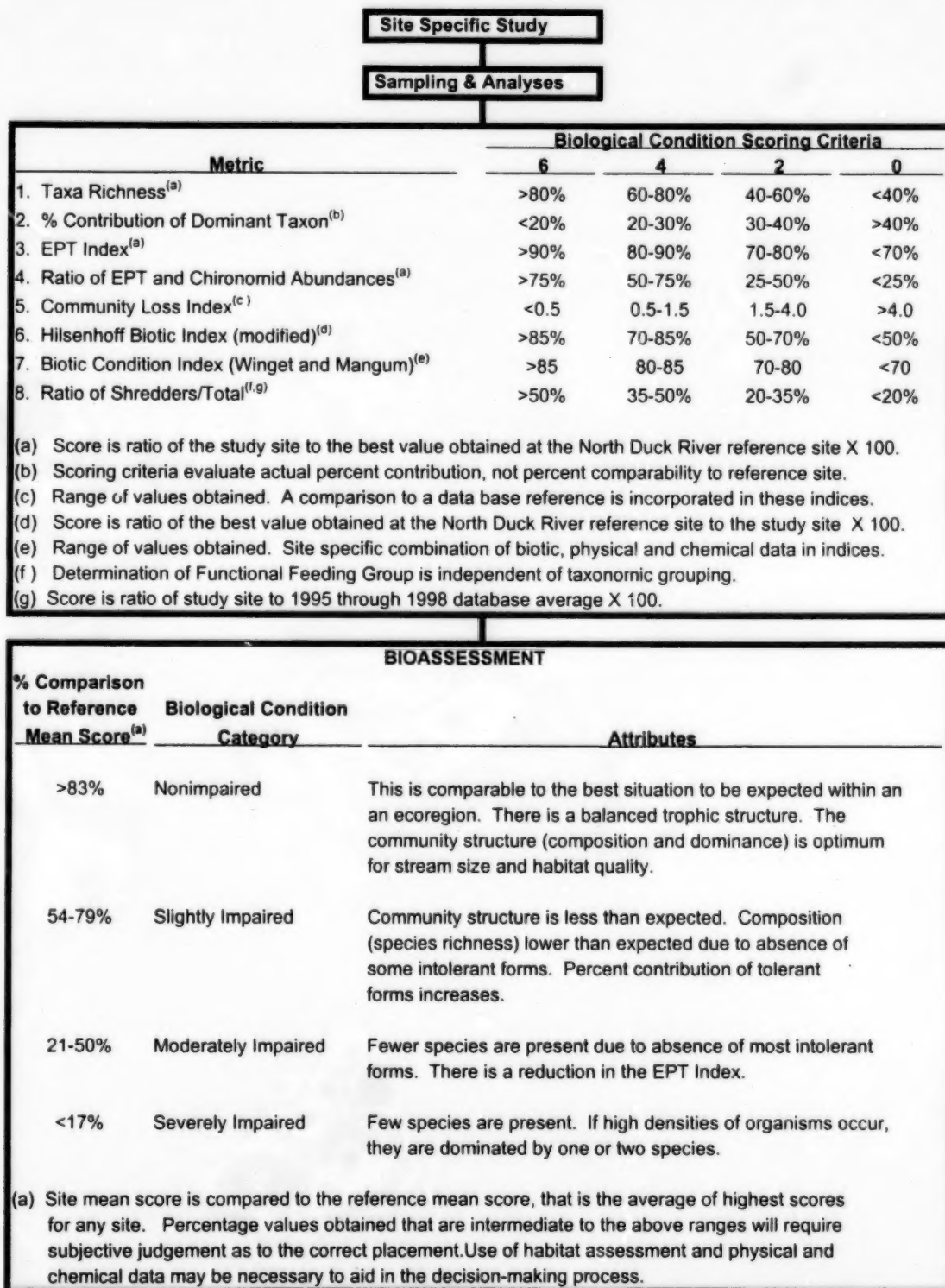


Figure 2. Bioassessment Flow Chart.

Table 1. Urban creeks macroinvertebrate indices.

Creek	Sample Number	Site Number	Date	Organisms /m ²	Taxa Richness	Dominant Taxon	EPT All Organisms Index	EPT Index	Chironomidae	EPT/C HBI	TQa Invertebrates	Top Predicted	BCI ² Loss	Community Scrapers	Filter Collectors	Scrapers/ Filter Collectors	Shredders	Shredders/ Total		
Bunns	98-53591	WQ1919	September-98	934	14	86%	1	1	2	50.0%	7.95	99	94	4.69	45	0	Infinite	2	0.2%	
Bunns	98-53592	WQ1920	September-98	209	12	60%	12	1	22	54.5%	8.38	99	94	6.08	0	0	0.0%	22	10.5%	
Bunns	98-53593	WQ1922	September-98	427	14	26%	129	2	40	32.3%	7.44	96	94	2.24	6	0	Infinite	24	5.6%	
Omands	97-33122	WQ0866	June-97	44	14	30%	0	0	16	0.0%	6.62	104	87	4.22	0	1	0.0%	1	2.3%	
Omands	97-59744	WQ0866	September-97	651	14	31%	5	2	213	2.3%	6.97	106	85	3.14	7	64	10.9%	8	1.2%	
Omands	97-33123	WQ1091	June-97	259	14	27%	0	0	161	0.0%	6.90	107	84	4.56	1	31	3.2%	1	0.4%	
Omands	97-59745	WQ1091	September-97	757	14	24%	10	2	317	3.2%	7.38	106	85	2.00	4	9	44.4%	7	0.9%	
Omands	97-33128	WQ1091.01	June-97	168	14	24%	0	0	41	0.0%	7.45	107	84	3.60	9	13	69.2%	0	0.0%	
Omands	97-59750	WQ1091.01	September-97	155	14	77%	4	2	13	30.8%	7.83	105	86	3.60	2	1	200%	1	0.6%	
Omands	97-33124	WQ1092	June-97	839	13	50%	0	0	234	0.0%	7.19	101	108	3.23	3	21	14.3%	4	0.5%	
Omands	97-59746	WQ1092	September-97	505	14	67%	35	1	10	350%	7.97	103	105	2.80	23	0	Infinite	8	1.6%	
Omands	97-33127	WQ1093	June-97	212	14	44%	0	0	13	0.0%	7.64	102	59	3.13	56	1	5600%	11	5.2%	
Omands	97-59749	WQ1093	September-97	215	12	54%	8	2	70	11.4%	8.58	104	58	7.50	1	0	Infinite	69	32.1%	
Omands	97-33125	WQ1844	June-97	587	14	28%	0	0	265	0.0%	6.65	100	60	2.96	1	2	50.0%	4	0.7%	
Omands	97-59747	WQ1844	September-97	856	14	86%	2	1	26	7.7%	7.91	107	56	2.80	14	1	1400%	8	0.9%	
Omands	97-33126	WQ1845	June-97	217	14	18%	0	0	120	0.0%	6.91	105	57	2.80	5	5	100%	40	18.4%	
Omands	97-59748	WQ1845	September-97	717	14	87%	0	0	11	0.0%	8.13	108	56	5.07	1	0	Infinite	10	1.4%	
Omands	98-35766	WQ0866	July-98	144	14	35%	0	0	35	0.0%	7.01	108	84	4.87	2	3	66.7%	1	0.7%	
Omands	98-53594	WQ0866	September-98	440	12	43%	0	0	313	0.0%	5.60	108	83	6.17	0	112	0.0%	0	0.0%	
Omands	98-35790	WQ1091.01	July-98	1077	14	84%	4	2	22	18.2%	7.70	107	84	3.84	24	91	26.4%	9	0.8%	
Omands	98-53595	WQ1092	September-98	129	14	44%	6	1	5	120%	7.80	89	67	3.14	22	1	2200%	3	2.3%	
Omands	98-53597	WQ1093	September-98	1441	12	98%	3	1	0	Infinite	7.99	108	56	7.00	3	0	Infinite	1	0.1%	
Omands	98-53596	WQ1844	September-98	5884	19	97%	14	1	8	175%	7.99	107	56	3.89	1	0	Infinite	1	0.0%	
Sturgeon	97-61130	WQ0775	September-97	785	20	49%	19	4	127	15.0%	6.91	107	84	3.40	27	237	11.4%	6	0.8%	
Sturgeon	97-61131	WQ0775.01	September-97	198	25	25%	11	2	49	22.4%	7.54	105	86	2.72	36	15	240%	18	9.1%	
Sturgeon	97-61439	WQ0776	September-97	105	11	51%	67	2	15	447%	6.16	82	108	6.73	20	0	Infinite	1	1.0%	
Sturgeon	97-61440	WQ0777	September-97	39	14	44%	17	1	7	243%	7.23	92	108	117	5.14	5	3	167%	3	7.7%
Truro	98-53590	WQ1042	September-98	122	11	59%	0	0	4	0.0%	8.42	107	56	6.82	73	0	Infinite	0	0.0%	
Truro	98-53581	WQ1045	September-98	12	6	42%	0	0	6	0.0%	8.36	102	88	13.17	1	0	Infinite	5	41.7%	
Mean Sample				625	14	51%	12	1	75	67%	7.47	103	81	4.53	14	21	NA	9	5.1%	

1. HBI or Hilsenhoff Biotic Index = Mean Hilsenhoff or equivalent tolerance values.

2. BCI or Biotic Condition Index = $(TQp/TQa) \times 100$. Where TQp = Mean Predicted Tolerance Quotient and TQa = Mean Actual Tolerance Quotient.

The numbers of organisms collected per sample varied considerably, ranging from 12 to 5884 organisms at site WQ1045 in Truro Creek and site WQ1844 in Sturgeon Creek, respectively (Table 1). Both of these samples were collected in September 1998. However, the use of multiple metrics as an assessment technique appears to provide a reasonably balanced perspective of biological condition. A sample size of at least 100 organisms per site per sampling date is recommended for accurate estimation of macroinvertebrate community health (Plafkin *et al.* 1989). Precautions should be taken when examining assessments with low numbers of organisms. The average number of organisms per sample was 625 and all but three samples included more than 100 organisms. As previously noted, the September 1998 sample from site WQ1045 in Truro Creek yielded only 12 organisms. Samples of 39 and 44 organisms were obtained in September 1997 at site WQ0777 in Sturgeon Creek and June 1997 at site WQ0866 in Omands Creek, respectively (Table 1). It is likely that the biological condition estimation for the Truro Creek sample would not be accurate although the biological condition indicated by the other two samples could be reasonably accurate as indicated by Hughes (2000).

Bunns Creek was only sampled in September 1998 and the macroinvertebrate communities varied from moderately to slightly impaired (Table 2). At the most upstream site WQ1919 (Figure 1) the biological condition indicated moderate impairment. At the mid-point site WQ1920 the biological condition indicated moderate to slight impairment. At the most downstream site WQ1922 the macroinvertebrate community was only slightly impaired.

Omands Creek was sampled in June and September of 1997 and July and September of 1998 and generally indicated moderate impairment of macroinvertebrate communities with one sample indicating severe impairment (Table 2). Table 3 shows the biological condition ratings for each sampling occasion from the most upstream site to the most downstream site in Omands Creek. Sites WQ1091 and WQ1091.01 are located in close proximity where both sites were sampled in June and September 1997 and only site WQ1091.01 was sampled in July of 1998. At the most upstream site WQ1093 and at the most downstream sites WQ1091, WQ1091.01, and WQ0866 showed relatively consistent results with moderate impairment observed for the macroinvertebrate communities in all samples (Figure 1 and Table 3). The centre three sites were more variable. Macroinvertebrates at site WQ1845 showed only moderate to slight impairment in July 1997 and severe impairment in September 1997. Macroinvertebrates at sites WQ1844 and WQ1092 showed moderate impairment in two out of three samples and severe to moderate impairment in one sample in each case.

Table 3. Omands Creek biological condition ratings at each water quality site from upstream to downstream (Figure 1).

Date	Water Quality Sites					
	WQ1093	WQ1845	WQ1844	WQ1092	WQ1091 & WQ1091.01	WQ0866
June 1997	Moderate Impairment	Moderate to Slight Impairment	Moderate Impairment	Moderate Impairment	Moderate Impairment	Moderate Impairment
September 1997	Moderate Impairment	Severe Impairment	Severe to Moderate Impairment	Moderate Impairment	Moderate Impairment	Moderate Impairment
July 1998	No Sample	No Sample	No Sample	No Sample	Moderate Impairment	Moderate Impairment
September 1998	Moderate Impairment	No Sample	Moderate Impairment	Severe to Moderate Impairment	No Sample	Moderate Impairment

Sturgeon Creek was only sampled in September of 1997. Macroinvertebrates at the most upstream site WQ0777 showed moderate to slight impairment (Figure 1). At the mid-

point site WQ0776, the macroinvertebrate community was moderately impaired. At the most downstream site WQ0775 and the adjacent site WQ0775.01 macroinvertebrate community condition indicated moderate and slight impairment, respectively.

Truro Creek was only sampled in September 1998. Since only 12 organisms were collected at the most upstream site WQ1045, it is likely that the assessment of moderate impairment of the macroinvertebrate community is in error (Table 2). More than half the organisms collected at this site were relatively hardy Chironomidae and Oligocheata (Appendix 1) and it is likely that this community was severely impaired at time of sampling. This would tend to be confirmed by the severe impairment noted for the downstream site WQ01042 (Table 2 and Figure 1).

Conclusions

- Bunns Creek macroinvertebrate communities were moderately to slightly impaired in September 1998.
- Omands Creek macroinvertebrate communities were generally moderately impaired in 1997 and 1998. This was the case for the most upstream and downstream locations. However, in the central portion of the stream there was more variation in environmental impact. In the case of these three sites, one sample indicated a severe impact, two samples indicated a severe to moderate impact, and one sample indicated a moderate to slight impact, and the remaining three samples indicated a moderate impact on the macroinvertebrate community.
- Sturgeon Creek macroinvertebrate communities were moderately to slightly impaired at the upstream and downstream locations and moderately impaired in the centre portion of the stream.
- Truro Creek macroinvertebrate communities from two sites appeared to be severely impaired. Although one sample was initially assessed through the use of rapid bioassessment techniques and was found to be moderately impaired, the low numbers of organisms in the sample and the predominance of hardy species of Chironomidae and Oligocheata would tend to indicate severe impairment. In this particular sample, only 12 organisms were collected and the recommended number of organisms for use of rapid bioassessment techniques is 100.

References

- Arkansas Department of Pollution Control & Ecology (ADPCE). 1989. State species list. As referenced in U.S. Environmental Protection Agency (EPA). 1994. Macroinvertebrate Species List, Version 1 (May, 1994).
- Courtemanch, D.L. and S.P. Davies. 1987. A coefficient of community loss to assess detrimental change in aquatic communities. *Water Res.* 21(2):217-222.
- Hilsenhoff, W.L. 1987. An improved biotic index of stream pollution. *Great Lakes Entomol.* 20:31-39.
- Holt, P.C. 1989. Comments on the classification of the Clitellata. *Hydrobiologica* 180: 1-5.
- Hughes C.E. 2001. Water and biological quality of twenty seven major streams in south and central, Manitoba, Canada, 1995 through 1998. Draft. Manitoba Conservation.
- Merritt, R.W. and K.W. Cummins, eds. 1984. An Introduction to the aquatic insects of North America. Second edition. Kendall/Hunt publishing Co., Dubuque, Iowa.
- New York Department of Environmental Conservation (NYDEC). 1989. Species list of tolerance and feeding habit. As referenced in U.S. Environmental Protection Agency (EPA). 1994. Macroinvertebrate Species List, Version 1 (May, 1994).
- Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. U.S. Environmental Protection Agency, Assessment and Watershed Protection Division. Washington, D.C. May 1989.
- Plotnikoff, R.W. 1994. Instream biological assessment monitoring. Protocols: benthic macroinvertebrates. Environmental Investigations and Laboratory Services Ambient Monitoring Section, Washington State Department of Ecology. Olympia, Washington. June 1994.
- U.S. Environmental Protection Agency (EPA). 1994. Macroinvertebrate species list, Version 1 (May, 1994). US EPA, Region 6, Environmental Services Division. Dallas, Texas.
- Winget, R.N. and F.A. Mangum. 1979. Aquatic ecosystem inventory, Macroinvertebrate Analysis. Biotic Condition Index: integrated biological physical, and chemical parameters for management. Prepared under contract for U.S. Department of Agriculture. Intermountain Region, Forest Service. October 17, 1979.

Appendices 1 through 4



Appendix 1. Macroinvertebrate taxa per sample from Bunn's, Omands, Sturgeon, and Truro creeks.

Creek	Site	Date	Lab ID	Phylum or Order	Class or Subclass	Genus and species or Taxonomic Group	Total Number
Bunn's	WQ1919	September-98	98-53591	Annelida	Hirudinea	<i>Dina</i> sp.	3
Bunn's	WQ1919	September-98	98-53591	Annelida	Hirudinea	<i>Glossiphonia complanata</i>	1
Bunn's	WQ1919	September-98	98-53591	Annelida	Hirudinea	<i>Theromyzon maculosum</i>	1
Bunn's	WQ1919	September-98	98-53591	Annelida	Oligochaeta	<i>Nais</i> sp.	6
Bunn's	WQ1919	September-98	98-53591	Coelenterata	Coelenterata	<i>Hydra</i> sp.	1
Bunn's	WQ1919	September-98	98-53591	Crustacea	Amphipoda	<i>Hyalella azteca</i>	804
Bunn's	WQ1919	September-98	98-53591	Gastropoda	Pulmonata	<i>Gyraulus</i> sp.	12
Bunn's	WQ1919	September-98	98-53591	Gastropoda	Pulmonata	<i>Physa</i> sp.	33
Bunn's	WQ1919	September-98	98-53591	Insecta	Coleoptera	<i>Halipius</i> sp.	2
Bunn's	WQ1919	September-98	98-53591	Insecta	Coleoptera	<i>Liodes affinis</i>	1
Bunn's	WQ1919	September-98	98-53591	Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.	2
Bunn's	WQ1919	September-98	98-53591	Insecta	Ephemeroptera	<i>Baetis</i> sp.	1
Bunn's	WQ1919	September-98	98-53591	Insecta	Hemiptera	<i>Callicorixa audeni</i>	1
Bunn's	WQ1919	September-98	98-53591	Insecta	Hemiptera	<i>Trichocorixa borealis</i>	1
Bunn's	WQ1919	September-98	98-53591	Insecta	Hemiptera	<i>Trichocorixa naia</i>	5
Bunn's	WQ1919	September-98	98-53591	Insecta	Odonata	<i>Enallagma</i> sp.	60
Bunn's	WQ1920	September-98	98-53592	Annelida	Hirudinea	<i>Dina</i> sp.	2
Bunn's	WQ1920	September-98	98-53592	Annelida	Oligochaeta	<i>Dero</i> sp.	25
Bunn's	WQ1920	September-98	98-53592	Annelida	Oligochaeta	<i>Nais</i> sp.	15
Bunn's	WQ1920	September-98	98-53592	Annelida	Oligochaeta	<i>Tubifex</i> sp.	2
Bunn's	WQ1920	September-98	98-53592	Crustacea	Amphipoda	<i>Hyalella azteca</i>	126
Bunn's	WQ1920	September-98	98-53592	Insecta	Coleoptera	<i>Halipius</i> sp.	1
Bunn's	WQ1920	September-98	98-53592	Insecta	Coleoptera	<i>Liodes affinis</i>	1
Bunn's	WQ1920	September-98	98-53592	Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	21
Bunn's	WQ1920	September-98	98-53592	Insecta	Diptera Chironomidae	<i>Procladius</i> sp.	1
Bunn's	WQ1920	September-98	98-53592	Insecta	Ephemeroptera	<i>Caenis</i> sp.	12
Bunn's	WQ1920	September-98	98-53592	Insecta	Hemiptera	<i>Sigara</i> sp.	1
Bunn's	WQ1920	September-98	98-53592	Insecta	Odonata	<i>Enallagma</i> sp.	2
Bunn's	WQ1922	September-98	98-53593	Annelida	Hirudinea	<i>Glossiphonia complanata</i>	1
Bunn's	WQ1922	September-98	98-53593	Annelida	Oligochaeta	<i>Dero</i> sp.	3
Bunn's	WQ1922	September-98	98-53593	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	6
Bunn's	WQ1922	September-98	98-53593	Annelida	Oligochaeta	<i>Nais</i> sp.	50
Bunn's	WQ1922	September-98	98-53593	Annelida	Oligochaeta	<i>Stylaria lacustris</i>	35
Bunn's	WQ1922	September-98	98-53593	Arachnoidae	Hydracarina	<i>Hydracarina</i> unidentified	12
Bunn's	WQ1922	September-98	98-53593	Coelenterata	Coelenterata	<i>Hydra</i> sp.	21
Bunn's	WQ1922	September-98	98-53593	Crustacea	Amphipoda	<i>Hyalella azteca</i>	99
Bunn's	WQ1922	September-98	98-53593	Gastropoda	Pulmonata	<i>Physa</i> sp.	6
Bunn's	WQ1922	September-98	98-53593	Insecta	Coleoptera	<i>Agabus</i> sp.	2
Bunn's	WQ1922	September-98	98-53593	Insecta	Coleoptera	<i>Halipius immaculicollis</i>	1
Bunn's	WQ1922	September-98	98-53593	Insecta	Coleoptera	<i>Hygroplitis</i> sp.	2
Bunn's	WQ1922	September-98	98-53593	Insecta	Coleoptera	<i>Liodes affinis</i>	2
Bunn's	WQ1922	September-98	98-53593	Insecta	Coleoptera	<i>Peltodytes edentulus</i>	2
Bunn's	WQ1922	September-98	98-53593	Insecta	Coleoptera	<i>Tropisternus</i> sp.	2
Bunn's	WQ1922	September-98	98-53593	Insecta	Diptera Chironomidae	<i>Chironomidae</i> unidentified	2
Bunn's	WQ1922	September-98	98-53593	Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	1
Bunn's	WQ1922	September-98	98-53593	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	6
Bunn's	WQ1922	September-98	98-53593	Insecta	Diptera Chironomidae	<i>Dicrotendipes</i> sp.	9
Bunn's	WQ1922	September-98	98-53593	Insecta	Diptera Chironomidae	<i>Endochironomus</i> sp.	16
Bunn's	WQ1922	September-98	98-53593	Insecta	Diptera Chironomidae	<i>Paratanytarsus</i> sp.	2
Bunn's	WQ1922	September-98	98-53593	Insecta	Diptera Chironomidae	<i>Polypedilum</i> sp.	4
Bunn's	WQ1922	September-98	98-53593	Insecta	Ephemeroptera	<i>Baetis</i> sp.	17
Bunn's	WQ1922	September-98	98-53593	Insecta	Ephemeroptera	<i>Caenis</i> sp.	112
Bunn's	WQ1922	September-98	98-53593	Insecta	Hemiptera	<i>Conixidae</i> unid.	1
Bunn's	WQ1922	September-98	98-53593	Insecta	Hemiptera	<i>Hesperocorixa</i> sp.	2
Bunn's	WQ1922	September-98	98-53593	Insecta	Hemiptera	<i>Sigara</i> sp.	5
Bunn's	WQ1922	September-98	98-53593	Insecta	Hemiptera	<i>Trichocorixa naia</i>	3
Bunn's	WQ1922	September-98	98-53593	Insecta	Odonata	<i>Enallagma</i> sp.	3
Omands	WQ0866	June-97	97-33122	Annelida	Oligochaeta	<i>Nais</i> sp.	4
Omands	WQ0866	June-97	97-33122	Annelida	Oligochaeta	<i>Tubifex tubifex</i>	6
Omands	WQ0866	June-97	97-33122	Arachnoidae	Hydracarina	<i>Hygrobatas</i> sp.	1
Omands	WQ0866	June-97	97-33122	Crustacea	Amphipoda	<i>Hyalella azteca</i>	7
Omands	WQ0866	June-97	97-33122	Insecta	Coleoptera	<i>Anacaena</i> sp.	1
Omands	WQ0866	June-97	97-33122	Insecta	Coleoptera	<i>Helophorus</i> sp.	1
Omands	WQ0866	June-97	97-33122	Insecta	Coleoptera	<i>Hydroporus</i> sp.	1
Omands	WQ0866	June-97	97-33122	Insecta	Diptera Chironomidae	<i>Corynoneura</i> sp.	1
Omands	WQ0866	June-97	97-33122	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	13
Omands	WQ0866	June-97	97-33122	Insecta	Diptera Chironomidae	<i>Fletcherimyia</i> sp.	1
Omands	WQ0866	June-97	97-33122	Insecta	Diptera Chironomidae	<i>Tanytarsus</i> sp.	1
Omands	WQ0866	June-97	97-33122	Insecta	Diptera Miscellaneous	<i>Palpomyia</i> sp.	1
Omands	WQ0866	June-97	97-33122	Insecta	Hemiptera	<i>Sigara</i> sp.	1
Omands	WQ0866	June-97	97-33122	Insecta	Odonata	<i>Enallagma</i> sp.	1
Omands	WQ0866	June-97	97-33122	Insecta	Odonata	<i>Ischnura</i> sp.	1
Omands	WQ0866	June-97	97-33122	Insecta	Odonata	<i>Stylurus</i> sp.	1
Omands	WQ0866	June-97	97-33122	Nematoda	Nematoda	<i>Nematoda</i> unidentified	1

Appendix 1. (continued).

Creek	Site	Date	Lab ID	Phylum or Order	Class or Subclass	Genus and species or Taxonomic Group	Total Number
Omands	WQ0866	September-97	97-59744	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	28
Omands	WQ0866	September-97	97-59744	Annelida	Oligochaeta	<i>Nais</i> sp.	202
Omands	WQ0866	September-97	97-59744	Annelida	Oligochaeta	<i>Tubifex tubifex</i>	71
Omands	WQ0866	September-97	97-59744	Crustacea	Amphipoda	<i>Hyalella azteca</i>	41
Omands	WQ0866	September-97	97-59744	Gastropoda	Pulmonata	<i>Physa</i> sp.	6
Omands	WQ0866	September-97	97-59744	Insecta	Coleoptera	<i>Hydrophilus</i> sp.	1
Omands	WQ0866	September-97	97-59744	Insecta	Coleoptera	<i>Laccophilus maculosus</i>	2
Omands	WQ0866	September-97	97-59744	Insecta	Coleoptera	<i>Liodessus affinis</i>	22
Omands	WQ0866	September-97	97-59744	Insecta	Coleoptera	<i>Ochthebius</i> sp.	1
Omands	WQ0866	September-97	97-59744	Insecta	Diptera Chironomidae	<i>Abiatomyia</i> sp.	6
Omands	WQ0866	September-97	97-59744	Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	8
Omands	WQ0866	September-97	97-59744	Insecta	Diptera Chironomidae	<i>Cladotanytarsus</i> sp.	3
Omands	WQ0866	September-97	97-59744	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	157
Omands	WQ0866	September-97	97-59744	Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.	31
Omands	WQ0866	September-97	97-59744	Insecta	Diptera Chironomidae	<i>Paramerina</i> sp.	2
Omands	WQ0866	September-97	97-59744	Insecta	Diptera Chironomidae	<i>Procladius</i> sp.	1
Omands	WQ0866	September-97	97-59744	Insecta	Diptera Chironomidae	<i>Tanytarsus</i> sp.	4
Omands	WQ0866	September-97	97-59744	Insecta	Diptera Chironomidae	<i>Thienemanniella</i> sp.	1
Omands	WQ0866	September-97	97-59744	Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	57
Omands	WQ0866	September-97	97-59744	Insecta	Ephemeroptera	<i>Baetis</i> sp.	1
Omands	WQ0866	September-97	97-59744	Insecta	Ephemeroptera	<i>Caenis</i> sp.	4
Omands	WQ0866	September-97	97-59744	Insecta	Hemiptera	<i>Sagaria</i> sp.	2
Omands	WQ0866	July-98	98-35766	Annelida	Hirudinea	<i>Dina</i> sp.	1
Omands	WQ0866	July-98	98-35766	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	2
Omands	WQ0866	July-98	98-35766	Annelida	Oligochaeta	<i>Nais</i> sp.	38
Omands	WQ0866	July-98	98-35766	Annelida	Oligochaeta	<i>Tubifex</i> sp.	2
Omands	WQ0866	July-98	98-35766	Arachnidae	Hydracarina	<i>Limnesia</i> sp.	1
Omands	WQ0866	July-98	98-35766	Crustacea	Amphipoda	<i>Hyalella azteca</i>	51
Omands	WQ0866	July-98	98-35766	Gastropoda	Pulmonata	<i>Gyratulus</i> sp.	1
Omands	WQ0866	July-98	98-35766	Gastropoda	Pulmonata	<i>Physa</i> sp.	1
Omands	WQ0866	July-98	98-35766	Insecta	Coleoptera	<i>Rhantus</i> sp.	1
Omands	WQ0866	July-98	98-35766	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	33
Omands	WQ0866	July-98	98-35766	Insecta	Diptera Chironomidae	<i>Glyptotendipes</i> sp.	1
Omands	WQ0866	July-98	98-35766	Insecta	Diptera Chironomidae	<i>Thienemanniella</i> sp.	1
Omands	WQ0866	July-98	98-35766	Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	2
Omands	WQ0866	July-98	98-35766	Insecta	Hemiptera	<i>Conidae unio</i>	8
Omands	WQ0866	July-98	98-35766	Insecta	Hemiptera	<i>Trichocorixa naia</i>	1
Omands	WQ1091	June-97	97-33123	Annelida	Hirudinea	<i>Nepheleopsis obscura</i>	1
Omands	WQ1091	June-97	97-33123	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	33
Omands	WQ1091	June-97	97-33123	Annelida	Oligochaeta	<i>Nais</i> sp.	1
Omands	WQ1091	June-97	97-33123	Annelida	Oligochaeta	<i>Stylodrilus heringianus</i>	1
Omands	WQ1091	June-97	97-33123	Annelida	Oligochaeta	<i>Tubifex</i> sp.	14
Omands	WQ1091	June-97	97-33123	Crustacea	Amphipoda	<i>Hyalella azteca</i>	42
Omands	WQ1091	June-97	97-33123	Gastropoda	Pulmonata	<i>Physa</i> sp.	1
Omands	WQ1091	June-97	97-33123	Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	1
Omands	WQ1091	June-97	97-33123	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	59
Omands	WQ1091	June-97	97-33123	Insecta	Diptera Chironomidae	<i>Diamasa</i> sp.	1
Omands	WQ1091	June-97	97-33123	Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.	69
Omands	WQ1091	June-97	97-33123	Insecta	Diptera Chironomidae	<i>Procladius</i> sp.	1
Omands	WQ1091	June-97	97-33123	Insecta	Diptera Chironomidae	<i>Tanytarsus</i> sp.	30
Omands	WQ1091	June-97	97-33123	Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	1
Omands	WQ1091	June-97	97-33123	Insecta	Odonata	<i>Enallagma</i> sp.	1
Omands	WQ1091	June-97	97-33123	Insecta	Odonata	<i>Ischnura</i> sp.	3
Omands	WQ1091	September-97	97-59745	Annelida	Hirudinea	<i>Dina</i> sp.	2
Omands	WQ1091	September-97	97-59745	Annelida	Hirudinea	<i>Epiobdella punctata</i>	1
Omands	WQ1091	September-97	97-59745	Annelida	Hirudinea	<i>Glossophonia complanata</i>	1
Omands	WQ1091	September-97	97-59745	Annelida	Hirudinea	<i>Helobdella stagnalis</i>	1
Omands	WQ1091	September-97	97-59745	Annelida	Hirudinea	<i>Theromyzon maculosum</i>	1
Omands	WQ1091	September-97	97-59745	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	16
Omands	WQ1091	September-97	97-59745	Annelida	Oligochaeta	<i>Nais</i> sp.	58
Omands	WQ1091	September-97	97-59745	Annelida	Oligochaeta	<i>Tubifex tubifex</i>	70
Omands	WQ1091	September-97	97-59745	Coelenterata	Coelenterata	<i>Hydra</i> sp.	2
Omands	WQ1091	September-97	97-59745	Crustacea	Amphipoda	<i>Hyalella azteca</i>	185
Omands	WQ1091	September-97	97-59745	Gastropoda	Ctenobranchiata	<i>Valvata</i> sp.	1
Omands	WQ1091	September-97	97-59745	Gastropoda	Pulmonata	<i>Physa</i> sp.	2
Omands	WQ1091	September-97	97-59745	Insecta	Coleoptera	<i>Gyrinus</i> sp.	1
Omands	WQ1091	September-97	97-59745	Insecta	Coleoptera	<i>Halpius</i> sp.	7
Omands	WQ1091	September-97	97-59745	Insecta	Coleoptera	<i>Hygroplitis</i> sp.	1
Omands	WQ1091	September-97	97-59745	Insecta	Coleoptera	<i>Liodessus affinis</i>	10
Omands	WQ1091	September-97	97-59745	Insecta	Coleoptera	<i>Ochthebius</i> sp.	1
Omands	WQ1091	September-97	97-59745	Insecta	Diptera Chironomidae	<i>Abiatomyia</i> sp.	6
Omands	WQ1091	September-97	97-59745	Insecta	Diptera Chironomidae	Chironomidae unidentified	96
Omands	WQ1091	September-97	97-59745	Insecta	Diptera Chironomidae	<i>Cladotanytarsus</i> sp.	2
Omands	WQ1091	September-97	97-59745	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	92
Omands	WQ1091	September-97	97-59745	Insecta	Diptera Chironomidae	<i>Cryptochironomus</i> sp.	1

Appendix 1. (continued).

Creek	Site	Date	Lab ID	Phylum or Order	Class or Subclass	Genus and species or Taxonomic Group	Total Number
Omands	WQ1091	September-97	97-59745	Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.	111
Omands	WQ1091	September-97	97-59745	Insecta	Diptera Chironomidae	<i>Procladius</i> sp.	2
Omands	WQ1091	September-97	97-59745	Insecta	Diptera Chironomidae	<i>Tanytarsus</i> sp.	7
Omands	WQ1091	September-97	97-59745	Insecta	Diptera Miscellaneous	<i>Palpomyia</i> sp.	7
Omands	WQ1091	September-97	97-59745	Insecta	Ephemeroptera	<i>Caenis</i> sp.	8
Omands	WQ1091	September-97	97-59745	Insecta	Ephemeroptera	<i>Callibaetis</i> sp.	2
Omands	WQ1091	September-97	97-59745	Insecta	Hemiptera	<i>Callicorixa audeni</i>	9
Omands	WQ1091	September-97	97-59745	Insecta	Hemiptera	<i>Corixidae</i> unid.	31
Omands	WQ1091	September-97	97-59745	Insecta	Hemiptera	<i>Sigara</i> sp.	9
Omands	WQ1091	September-97	97-59745	Insecta	Hemiptera	<i>Trichocorixa naia</i> s	12
Omands	WQ1091	September-97	97-59745	Insecta	Odonata	<i>Ischnura</i> sp.	2
Omands	WQ1091.01	June-97	97-33128	Annelida	Hirudinea	<i>Dina</i> sp.	25
Omands	WQ1091.01	June-97	97-33128	Annelida	Hirudinea	<i>Erpobdella</i> sp.	4
Omands	WQ1091.01	June-97	97-33128	Annelida	Hirudinea	<i>Glossiphonia complanata</i>	41
Omands	WQ1091.01	June-97	97-33128	Annelida	Oligochaeta	<i>Nais</i> sp.	13
Omands	WQ1091.01	June-97	97-33128	Annelida	Oligochaeta	<i>Pristina</i> sp.	6
Omands	WQ1091.01	June-97	97-33128	Annelida	Oligochaeta	Tubificidae unidentifed	5
Omands	WQ1091.01	June-97	97-33128	Coelenterata	Coelenterata	<i>Hydra</i> sp.	3
Omands	WQ1091.01	June-97	97-33128	Crustacea	Amphipoda	<i>Hyalella azteca</i>	12
Omands	WQ1091.01	June-97	97-33128	Gastropoda	Pulmonata	<i>Lymnaea</i> sp.	7
Omands	WQ1091.01	June-97	97-33128	Gastropoda	Pulmonata	<i>Physa</i> sp.	2
Omands	WQ1091.01	June-97	97-33128	Insecta	Coleoptera	<i>Laccornis</i> sp.	2
Omands	WQ1091.01	June-97	97-33128	Insecta	Coleoptera	<i>Rhantus</i> sp.	2
Omands	WQ1091.01	June-97	97-33128	Insecta	Diptera Chironomidae	<i>Ablabesmyia</i> sp.	3
Omands	WQ1091.01	June-97	97-33128	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	9
Omands	WQ1091.01	June-97	97-33128	Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.	16
Omands	WQ1091.01	June-97	97-33128	Insecta	Diptera Chironomidae	<i>Procladius</i> sp.	2
Omands	WQ1091.01	June-97	97-33128	Insecta	Diptera Chironomidae	<i>Tanytarsus</i> sp.	11
Omands	WQ1091.01	June-97	97-33128	Insecta	Diptera Miscellaneous	<i>Palpomyia</i> sp.	1
Omands	WQ1091.01	June-97	97-33128	Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	2
Omands	WQ1091.01	June-97	97-33128	Insecta	Hemiptera	<i>Corixidae</i> unid.	2
Omands	WQ1091.01	September-97	97-59750	Annelida	Hirudinea	<i>Dina</i> sp.	2
Omands	WQ1091.01	September-97	97-59750	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	2
Omands	WQ1091.01	September-97	97-59750	Annelida	Oligochaeta	<i>Nais</i> sp.	2
Omands	WQ1091.01	September-97	97-59750	Coelenterata	Coelenterata	<i>Hydra</i> sp.	1
Omands	WQ1091.01	September-97	97-59750	Crustacea	Amphipoda	<i>Hyalella azteca</i>	119
Omands	WQ1091.01	September-97	97-59750	Gastropoda	Pulmonata	<i>Gyraulus</i> sp.	1
Omands	WQ1091.01	September-97	97-59750	Insecta	Coleoptera	<i>Enochrus</i> sp.	1
Omands	WQ1091.01	September-97	97-59750	Insecta	Coleoptera	<i>Ochthebius</i> sp.	1
Omands	WQ1091.01	September-97	97-59750	Insecta	Coleoptera	<i>Paracymus</i> sp.	1
Omands	WQ1091.01	September-97	97-59750	Insecta	Coleoptera	<i>Peltodytes edentulus</i>	1
Omands	WQ1091.01	September-97	97-59750	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	4
Omands	WQ1091.01	September-97	97-59750	Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.	9
Omands	WQ1091.01	September-97	97-59750	Insecta	Diptera Miscellaneous	<i>Palpomyia</i> sp.	1
Omands	WQ1091.01	September-97	97-59750	Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	1
Omands	WQ1091.01	September-97	97-59750	Insecta	Ephemeroptera	<i>Caenis</i> sp.	1
Omands	WQ1091.01	September-97	97-59750	Insecta	Ephemeroptera	<i>Callibaetis</i> sp.	3
Omands	WQ1091.01	September-97	97-59750	Insecta	Hemiptera	<i>Mesovelia</i> sp.	1
Omands	WQ1091.01	September-97	97-59750	Insecta	Hemiptera	<i>Sigara</i> sp.	1
Omands	WQ1091.01	September-97	97-59750	Insecta	Odonata	<i>Enallagma</i> sp.	2
Omands	WQ1091.01	September-97	97-59750	Insecta	Odonata	<i>Ischnura</i> sp.	1
Omands	WQ1091.1	July-98	98-35780	Annelida	Hirudinea	<i>Dina</i> sp.	15
Omands	WQ1091.1	July-98	98-35780	Annelida	Hirudinea	<i>Erpobdella</i> sp.	2
Omands	WQ1091.1	July-98	98-35780	Annelida	Hirudinea	<i>Helobdella stagnalis</i>	2
Omands	WQ1091.1	July-98	98-35780	Annelida	Oligochaeta	<i>Nais</i> sp.	1
Omands	WQ1091.1	July-98	98-35780	Annelida	Oligochaeta	<i>Stylaria lacustris</i>	3
Omands	WQ1091.1	July-98	98-35780	Arachnoidae	Hydracanna	<i>Limnesia</i> sp.	1
Omands	WQ1091.1	July-98	98-35780	Crustacea	Amphipoda	<i>Hyalella azteca</i>	904
Omands	WQ1091.1	July-98	98-35780	Gastropoda	Pulmonata	<i>Gyraulus</i> sp.	12
Omands	WQ1091.1	July-98	98-35780	Gastropoda	Pulmonata	<i>Lymnaea</i> sp.	1
Omands	WQ1091.1	July-98	98-35780	Gastropoda	Pulmonata	<i>Physa</i> sp.	11
Omands	WQ1091.1	July-98	98-35780	Insecta	Coleoptera	<i>Berosus</i> sp.	1
Omands	WQ1091.1	July-98	98-35780	Insecta	Coleoptera	<i>Dytiscus</i> sp.	1
Omands	WQ1091.1	July-98	98-35780	Insecta	Coleoptera	<i>Halpius</i> sp.	8
Omands	WQ1091.1	July-98	98-35780	Insecta	Coleoptera	<i>Peltodytes</i> sp.	1
Omands	WQ1091.1	July-98	98-35780	Insecta	Diptera Chironomidae	<i>Ablabesmyia</i> sp.	3
Omands	WQ1091.1	July-98	98-35780	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	19
Omands	WQ1091.1	July-98	98-35780	Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	88
Omands	WQ1091.1	July-98	98-35780	Insecta	Ephemeroptera	<i>Caenis</i> sp.	1
Omands	WQ1091.1	July-98	98-35780	Insecta	Trichoptera	<i>Cheumatopsyche</i> sp.	3
Omands	WQ1092	June-97	97-33124	Arachnoidae	Hydracanna	<i>Hydrachna</i> sp.	2
Omands	WQ1092	June-97	97-33124	Crustacea	Amphipoda	<i>Hyalella azteca</i>	421
Omands	WQ1092	June-97	97-33124	Gastropoda	Pulmonata	<i>Physa</i> sp.	3
Omands	WQ1092	June-97	97-33124	Insecta	Coleoptera	<i>Berosus</i> sp.	1
Omands	WQ1092	June-97	97-33124	Insecta	Coleoptera	<i>Graphoderus occidentalis</i>	1

Appendix 1. (continued).

Creek	Site	Date	Lab ID	Phylum or Order	Class or Subclass	Genus and species or Taxonomic Group	Total Number
Omands	WQ1092	June-97	97-33124	Insecta	Coleoptera	<i>Halipius borealis</i>	3
Omands	WQ1092	June-97	97-33124	Insecta	Coleoptera	<i>Hygrotus sp.</i>	1
Omands	WQ1092	June-97	97-33124	Insecta	Coleoptera	<i>Rhantus sp.</i>	139
Omands	WQ1092	June-97	97-33124	Insecta	Diptera Chironomidae	Chironomidae unidentified	120
Omands	WQ1092	June-97	97-33124	Insecta	Diptera Chironomidae	<i>Corynoneura sp.</i>	2
Omands	WQ1092	June-97	97-33124	Insecta	Diptera Chironomidae	<i>Cricotopus sp.</i>	8
Omands	WQ1092	June-97	97-33124	Insecta	Diptera Chironomidae	<i>Isocladius sp.</i>	74
Omands	WQ1092	June-97	97-33124	Insecta	Diptera Chironomidae	<i>Parachironomus sp.</i>	1
Omands	WQ1092	June-97	97-33124	Insecta	Diptera Chironomidae	<i>Polypedilum sp.</i>	1
Omands	WQ1092	June-97	97-33124	Insecta	Diptera Chironomidae	<i>Procladius sp.</i>	7
Omands	WQ1092	June-97	97-33124	Insecta	Diptera Chironomidae	<i>Tanytarsus sp.</i>	21
Omands	WQ1092	June-97	97-33124	Insecta	Diptera Miscellaneous	<i>Palpomyia sp.</i>	1
Omands	WQ1092	June-97	97-33124	Insecta	Hemiptera	Coridae unidentified	11
Omands	WQ1092	June-97	97-33124	Insecta	Hemiptera	<i>Notonecta sp.</i>	4
Omands	WQ1092	June-97	97-33124	Insecta	Hemiptera	<i>Sigara sp.</i>	1
Omands	WQ1092	June-97	97-33124	Insecta	Odonata	<i>Enallagma sp.</i>	17
Omands	WQ1092	September-97	97-59746	Annelida	Hirudinea	<i>Dina sp.</i>	2
Omands	WQ1092	September-97	97-59746	Annelida	Hirudinea	<i>Glossiphonia complanata</i>	1
Omands	WQ1092	September-97	97-59746	Annelida	Oligochaeta	<i>Limnodrilus sp.</i>	30
Omands	WQ1092	September-97	97-59746	Annelida	Oligochaeta	<i>Nais sp.</i>	2
Omands	WQ1092	September-97	97-59746	Annelida	Oligochaeta	<i>Tubifex tubifex</i>	26
Omands	WQ1092	September-97	97-59746	Crustacea	Amphipoda	<i>Hyalella azteca</i>	339
Omands	WQ1092	September-97	97-59746	Gastropoda	Pulmonata	<i>Gyraulus sp.</i>	3
Omands	WQ1092	September-97	97-59746	Gastropoda	Pulmonata	<i>Lymnaea sp.</i>	1
Omands	WQ1092	September-97	97-59746	Gastropoda	Pulmonata	<i>Physa sp.</i>	19
Omands	WQ1092	September-97	97-59746	Insecta	Coleoptera	<i>Colymbetes sp.</i>	1
Omands	WQ1092	September-97	97-59746	Insecta	Coleoptera	<i>Halipius sp.</i>	6
Omands	WQ1092	September-97	97-59746	Insecta	Coleoptera	<i>Hydroporus sp.</i>	1
Omands	WQ1092	September-97	97-59746	Insecta	Coleoptera	<i>Liodessus affinis</i>	1
Omands	WQ1092	September-97	97-59746	Insecta	Coleoptera	<i>Rhantus sp.</i>	1
Omands	WQ1092	September-97	97-59746	Insecta	Diptera Chironomidae	Chironomidae unidentified	1
Omands	WQ1092	September-97	97-59746	Insecta	Diptera Chironomidae	<i>Chironomus sp.</i>	2
Omands	WQ1092	September-97	97-59746	Insecta	Diptera Chironomidae	<i>Cricotopus sp.</i>	5
Omands	WQ1092	September-97	97-59746	Insecta	Diptera Chironomidae	<i>Isocladius sp.</i>	2
Omands	WQ1092	September-97	97-59746	Insecta	Diptera Miscellaneous	<i>Palpomyia sp.</i>	2
Omands	WQ1092	September-97	97-59746	Insecta	Ephemeroptera	<i>Caenis sp.</i>	35
Omands	WQ1092	September-97	97-59746	Insecta	Hemiptera	Coridae unid	1
Omands	WQ1092	September-97	97-59746	Insecta	Odonata	<i>Enallagma sp.</i>	3
Omands	WQ1092	September-97	97-59746	Insecta	Odonata	<i>Ischnura sp.</i>	18
Omands	WQ1092	September-97	97-59746	Insecta	Odonata	<i>Leucorrhinia sp.</i>	1
Omands	WQ1092	September-97	97-59746	Nematoda	Nematoda	Nematoda unidentified	2
Omands	WQ1093	June-97	97-33127	Annelida	Hirudinea	<i>Nepheleopsis obscura</i>	1
Omands	WQ1093	June-97	97-33127	Annelida	Hirudinea	<i>Theromyzon maculosum</i>	1
Omands	WQ1093	June-97	97-33127	Annelida	Oligochaeta	<i>Nais sp.</i>	12
Omands	WQ1093	June-97	97-33127	Annelida	Oligochaeta	<i>Stylaria lacustris</i>	1
Omands	WQ1093	June-97	97-33127	Arachnoidae	Hydracarina	<i>Dipodontus sp.</i>	2
Omands	WQ1093	June-97	97-33127	Arachnoidae	Hydracarina	<i>Eylais sp.</i>	1
Omands	WQ1093	June-97	97-33127	Arachnoidae	Hydracarina	<i>Hygrobatas sp.</i>	1
Omands	WQ1093	June-97	97-33127	Arachnoidae	Hydracarina	<i>Limnesia sp.</i>	2
Omands	WQ1093	June-97	97-33127	Coelenterata	Coelenterata	<i>Hydra sp.</i>	1
Omands	WQ1093	June-97	97-33127	Crustacea	Amphipoda	<i>Hyalella azteca</i>	94
Omands	WQ1093	June-97	97-33127	Gastropoda	Pulmonata	<i>Gyraulus sp.</i>	3
Omands	WQ1093	June-97	97-33127	Gastropoda	Pulmonata	<i>Helisoma sp.</i>	1
Omands	WQ1093	June-97	97-33127	Gastropoda	Pulmonata	<i>Physa sp.</i>	51
Omands	WQ1093	June-97	97-33127	Gastropoda	Pulmonata	<i>Promeneius sp.</i>	1
Omands	WQ1093	June-97	97-33127	Insecta	Coleoptera	<i>Halipius borealis</i>	11
Omands	WQ1093	June-97	97-33127	Insecta	Coleoptera	<i>Hydroporus sp.</i>	1
Omands	WQ1093	June-97	97-33127	Insecta	Coleoptera	<i>Laccophilus sp.</i>	1
Omands	WQ1093	June-97	97-33127	Insecta	Diptera Chironomidae	<i>Cricotopus sp.</i>	1
Omands	WQ1093	June-97	97-33127	Insecta	Diptera Chironomidae	<i>Isocladius sp.</i>	2
Omands	WQ1093	June-97	97-33127	Insecta	Diptera Chironomidae	<i>Parachironomus sp.</i>	2
Omands	WQ1093	June-97	97-33127	Insecta	Diptera Chironomidae	<i>Rheocricotopus sp.</i>	7
Omands	WQ1093	June-97	97-33127	Insecta	Diptera Chironomidae	<i>Tanytarsus sp.</i>	1
Omands	WQ1093	June-97	97-33127	Insecta	Odonata	<i>Enallagma sp.</i>	13
Omands	WQ1093	June-97	97-33127	Insecta	Odonata	<i>Leucorrhinia sp.</i>	1
Omands	WQ1093	September-97	97-59749	Annelida	Hirudinea	<i>Glossiphonia complanata</i>	1
Omands	WQ1093	September-97	97-59749	Annelida	Hirudinea	<i>Nepheleopsis obscura</i>	1
Omands	WQ1093	September-97	97-59749	Crustacea	Amphipoda	<i>Hyalella azteca</i>	117
Omands	WQ1093	September-97	97-59749	Gastropoda	Pulmonata	<i>Physa sp.</i>	1
Omands	WQ1093	September-97	97-59749	Insecta	Diptera Chironomidae	<i>Chironomus sp.</i>	69
Omands	WQ1093	September-97	97-59749	Insecta	Diptera Chironomidae	<i>Procladius sp.</i>	1
Omands	WQ1093	September-97	97-59749	Insecta	Ephemeroptera	<i>Baetis sp.</i>	1
Omands	WQ1093	September-97	97-59749	Insecta	Ephemeroptera	<i>Caenis sp.</i>	7
Omands	WQ1093	September-97	97-59749	Insecta	Odonata	<i>Enallagma sp.</i>	16
Omands	WQ1093	September-97	97-59749	Insecta	Odonata	<i>Plathemis sp.</i>	1

Appendix 1. (continued).

Creek	Site	Date	Lab ID	Phylum or Order	Class or Subclass	Genus and species or Taxonomic Group	Total Number
Omands	WQ1093	September-98	98-53597	Annelida	Hirudinea	<i>Helobdella stagnalis</i>	1
Omands	WQ1093	September-98	98-53597	Annelida	Oligochaeta	<i>Nais</i> sp.	3
Omands	WQ1093	September-98	98-53597	Arachnoidae	Hydracarina	<i>Arrenurus</i> sp.	3
Omands	WQ1093	September-98	98-53597	Arachnoidae	Hydracarina	<i>Limnesia</i> sp.	1
Omands	WQ1093	September-98	98-53597	Crustacea	Amphipoda	<i>Hyalella azteca</i>	1415
Omands	WQ1093	September-98	98-53597	Gastropoda	Pulmonata	<i>Physa</i> sp.	3
Omands	WQ1093	September-98	98-53597	Insecta	Coleoptera	<i>Haliphus</i> sp.	1
Omands	WQ1093	September-98	98-53597	Insecta	Ephemeroptera	<i>Caenis</i> sp.	3
Omands	WQ1093	September-98	98-53597	Insecta	Hemiptera	<i>Mesovelia</i> sp.	1
Omands	WQ1093	September-98	98-53597	Insecta	Hemiptera	<i>Plea striola</i>	1
Omands	WQ1093	September-98	98-53597	Insecta	Odonata	<i>Enallagma</i> sp.	9
Omands	WQ1779	June-97	97-33125	Arachnoidae	Hydracarina	<i>Eylais</i> sp.	2
Omands	WQ1779	June-97	97-33125	Arachnoidae	Hydracarina	<i>Limnesia</i> sp.	3
Omands	WQ1779	June-97	97-33125	Crustacea	Amphipoda	<i>Hyalella azteca</i>	149
Omands	WQ1779	June-97	97-33125	Gastropoda	Pulmonata	<i>Physa</i> sp.	1
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Agabus</i> sp.	1
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Berosus</i> sp.	2
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Dytiscus</i> sp.	1
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Haliphus borealis</i>	2
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Haliphus</i> sp.	2
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Hydroporus</i> sp.	1
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Hygrotus</i> sp.	4
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Laccophilus</i> sp.	37
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Liodessus</i> sp.	2
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Rhantus</i> sp.	66
Omands	WQ1779	June-97	97-33125	Insecta	Coleoptera	<i>Ablabesmyia</i> sp.	11
Omands	WQ1779	June-97	97-33125	Insecta	Diptera Chironomidae	Chironomidae unidentified	163
Omands	WQ1779	June-97	97-33125	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	1
Omands	WQ1779	June-97	97-33125	Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.	36
Omands	WQ1779	June-97	97-33125	Insecta	Diptera Chironomidae	<i>Parachironomus</i> sp.	2
Omands	WQ1779	June-97	97-33125	Insecta	Diptera Chironomidae	<i>Rheocricotopus</i> sp.	50
Omands	WQ1779	June-97	97-33125	Insecta	Diptera Chironomidae	<i>Tanytarsus</i> sp.	2
Omands	WQ1779	June-97	97-33125	Insecta	Hemiptera	<i>Corixidae</i> unid.	40
Omands	WQ1779	June-97	97-33125	Insecta	Hemiptera	<i>Notonecta</i> sp.	2
Omands	WQ1779	June-97	97-33125	Insecta	Hemiptera	<i>Salidula</i> sp.	1
Omands	WQ1779	June-97	97-33125	Insecta	Odonata	<i>Enallagma</i> sp.	6
Omands	WQ1780	June-97	97-33126	Annelida	Hirudinea	<i>Dina</i> sp.	3
Omands	WQ1780	June-97	97-33126	Annelida	Hirudinea	<i>Glossiphonia complanata</i>	5
Omands	WQ1780	June-97	97-33126	Annelida	Hirudinea	<i>Helobdella stagnalis</i>	27
Omands	WQ1780	June-97	97-33126	Annelida	Hirudinea	<i>Nepheleopsis obscura</i>	5
Omands	WQ1780	June-97	97-33126	Annelida	Oligochaeta	<i>Nais</i> sp.	21
Omands	WQ1780	June-97	97-33126	Annelida	Oligochaeta	<i>Paranais</i> sp.	2
Omands	WQ1780	June-97	97-33126	Arachnoidae	Hydracarina	<i>Piona</i> sp.	1
Omands	WQ1780	June-97	97-33126	Crustacea	Amphipoda	<i>Hyalella azteca</i>	8
Omands	WQ1780	June-97	97-33126	Gastropoda	Pulmonata	<i>Physa</i> sp.	5
Omands	WQ1780	June-97	97-33126	Insecta	Coleoptera	<i>Coptotomus</i> sp.	1
Omands	WQ1780	June-97	97-33126	Insecta	Coleoptera	<i>Haliphus borealis</i>	2
Omands	WQ1780	June-97	97-33126	Insecta	Coleoptera	<i>Helophorus</i> sp.	9
Omands	WQ1780	June-97	97-33126	Insecta	Coleoptera	<i>Rhantus frontalis</i>	1
Omands	WQ1780	June-97	97-33126	Insecta	Coleoptera	<i>Rhantus</i> sp.	1
Omands	WQ1780	June-97	97-33126	Insecta	Diptera Chironomidae	Chironomidae unidentified	7
Omands	WQ1780	June-97	97-33126	Insecta	Diptera Chironomidae	<i>Chironomus plumosus</i>	29
Omands	WQ1780	June-97	97-33126	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	38
Omands	WQ1780	June-97	97-33126	Insecta	Diptera Chironomidae	<i>Derotanytus</i> sp.	1
Omands	WQ1780	June-97	97-33126	Insecta	Diptera Chironomidae	<i>Einfeldia</i> sp.	6
Omands	WQ1780	June-97	97-33126	Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.	30
Omands	WQ1780	June-97	97-33126	Insecta	Diptera Chironomidae	<i>Procladius</i> sp.	4
Omands	WQ1780	June-97	97-33126	Insecta	Diptera Chironomidae	<i>Tanytarsus</i> sp.	5
Omands	WQ1780	June-97	97-33126	Insecta	Hemiptera	<i>Corixidae</i> unid.	2
Omands	WQ1780	June-97	97-33126	Insecta	Odonata	<i>Enallagma</i> sp.	1
Omands	WQ1780	June-97	97-33126	Insecta	Odonata	<i>Ischnura</i> sp.	3
Omands	WQ1844	September-97	97-59747	Annelida	Hirudinea	<i>Dina</i> sp.	2
Omands	WQ1844	September-97	97-59747	Annelida	Hirudinea	<i>Glossiphonia complanata</i>	3
Omands	WQ1844	September-97	97-59747	Annelida	Hirudinea	<i>Helobdella stagnalis</i>	5
Omands	WQ1844	September-97	97-59747	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	6
Omands	WQ1844	September-97	97-59747	Annelida	Oligochaeta	<i>Stylaria lacustris</i>	21
Omands	WQ1844	September-97	97-59747	Arachnoidae	Hydracarina	<i>Limnesia</i> sp.	1
Omands	WQ1844	September-97	97-59747	Crustacea	Amphipoda	<i>Hyalella azteca</i>	738
Omands	WQ1844	September-97	97-59747	Gastropoda	Pulmonata	<i>Gyrulus</i> sp.	3
Omands	WQ1844	September-97	97-59747	Gastropoda	Pulmonata	<i>Physa</i> sp.	11
Omands	WQ1844	September-97	97-59747	Insecta	Coleoptera	<i>Agabus</i> sp.	1
Omands	WQ1844	September-97	97-59747	Insecta	Coleoptera	<i>Haliphus</i> sp.	4
Omands	WQ1844	September-97	97-59747	Insecta	Coleoptera	<i>Laccophilus maculosus</i>	2
Omands	WQ1844	September-97	97-59747	Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	4
Omands	WQ1844	September-97	97-59747	Insecta	Diptera Chironomidae	<i>Corynoneura</i> sp.	1

Appendix 1. (continued).

Creek	Site	Date	Lab ID	Phylum or Order	Class or Subclass	Genus and species or Taxonomic Group	Total Number
Omands	WQ1844	September-97	97-59747	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	3
Omands	WQ1844	September-97	97-59747	Insecta	Diptera Chironomidae	<i>Lauterborniella</i> sp.	1
Omands	WQ1844	September-97	97-59747	Insecta	Diptera Chironomidae	<i>Monodiamesa</i> sp.	12
Omands	WQ1844	September-97	97-59747	Insecta	Diptera Chironomidae	<i>Paratanytarsus</i> sp.	4
Omands	WQ1844	September-97	97-59747	Insecta	Diptera Chironomidae	<i>Paratendipes</i> sp.	1
Omands	WQ1844	September-97	97-59747	Insecta	Diptera Miscellaneous	<i>Palpomyia</i> sp.	2
Omands	WQ1844	September-97	97-59747	Insecta	Ephemeroptera	<i>Caenis</i> sp.	2
Omands	WQ1844	September-97	97-59747	Insecta	Hemiptera	<i>Trichocorixa</i> naia	15
Omands	WQ1844	September-97	97-59747	Insecta	Odonata	<i>Enallagma</i> sp.	2
Omands	WQ1844	September-97	97-59747	Insecta	Odonata	<i>Ischnura</i> sp.	11
Omands	WQ1844	September-97	97-59747	Pelecypoda	Sphaeriidae	<i>Pisidium</i> sp.	1
Omands	WQ1845	September-97	97-59748	Annelida	Hirudinea	<i>Dina</i> sp.	5
Omands	WQ1845	September-97	97-59748	Annelida	Hirudinea	<i>Erpobdella punctata</i>	3
Omands	WQ1845	September-97	97-59748	Annelida	Hirudinea	<i>Glossiphonia complanata</i>	6
Omands	WQ1845	September-97	97-59748	Annelida	Hirudinea	<i>Helobdella stagnalis</i>	11
Omands	WQ1845	September-97	97-59748	Annelida	Hirudinea	<i>Nepheleopsis obscura</i>	1
Omands	WQ1845	September-97	97-59748	Annelida	Hirudinea	<i>Percymorensis marmoratis</i>	1
Omands	WQ1845	September-97	97-59748	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	25
Omands	WQ1845	September-97	97-59748	Annelida	Oligochaeta	<i>Tubifex</i> sp.	24
Omands	WQ1845	September-97	97-59748	Arachnoidae	Hydracarina	Hydracarina unidentified	1
Omands	WQ1845	September-97	97-59748	Crustacea	Amphipoda	<i>Hyalella azteca</i>	622
Omands	WQ1845	September-97	97-59748	Gastropoda	Pulmonata	<i>Physa</i> sp.	1
Omands	WQ1845	September-97	97-59748	Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	10
Omands	WQ1845	September-97	97-59748	Insecta	Diptera Chironomidae	<i>Derotanyptus</i> sp.	1
Omands	WQ1845	September-97	97-59748	Insecta	Hemiptera	<i>Trichocorixa</i> naia	4
Omands	WQ1845	September-97	97-59748	Nematoda	Nematoda	Nematoda unidentified	2
Omands	WQ0866	September-98	98-53594	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	2
Omands	WQ0866	September-98	98-53594	Annelida	Oligochaeta	<i>Nais</i> sp.	1
Omands	WQ0866	September-98	98-53594	Annelida	Oligochaeta	<i>Stylaria lacustris</i>	6
Omands	WQ0866	September-98	98-53594	Annelida	Oligochaeta	<i>Tubifex</i> sp.	8
Omands	WQ0866	September-98	98-53594	Crustacea	Amphipoda	<i>Hyalella azteca</i>	8
Omands	WQ0866	September-98	98-53594	Insecta	Diptera Chironomidae	Chironomidae unidentified	17
Omands	WQ0866	September-98	98-53594	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	83
Omands	WQ0866	September-98	98-53594	Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.	189
Omands	WQ0866	September-98	98-53594	Insecta	Diptera Chironomidae	<i>Paratanytarsus</i> sp.	2
Omands	WQ0866	September-98	98-53594	Insecta	Diptera Chironomidae	<i>Tanytarsus</i> sp.	10
Omands	WQ0866	September-98	98-53594	Insecta	Diptera Chironomidae	<i>Thienemannimyia</i> sp.	12
Omands	WQ0866	September-98	98-53594	Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	102
Omands	WQ1092	September-98	98-53595	Annelida	Hirudinea	<i>Glossiphonia complanata</i>	2
Omands	WQ1092	September-98	98-53595	Annelida	Hirudinea	<i>Helobdella stagnalis</i>	1
Omands	WQ1092	September-98	98-53595	Annelida	Oligochaeta	<i>Nais</i> sp.	9
Omands	WQ1092	September-98	98-53595	Crustacea	Amphipoda	<i>Hyalella azteca</i>	23
Omands	WQ1092	September-98	98-53595	Gastropoda	Pulmonata	<i>Gyraulus</i> sp.	2
Omands	WQ1092	September-98	98-53595	Gastropoda	Pulmonata	<i>Physa</i> sp.	20
Omands	WQ1092	September-98	98-53595	Insecta	Coleoptera	<i>Halophilus</i> sp.	1
Omands	WQ1092	September-98	98-53595	Insecta	Coleoptera	<i>Hygroplitis</i> sp.	1
Omands	WQ1092	September-98	98-53595	Insecta	Coleoptera	<i>Pelodytes edentulus</i>	1
Omands	WQ1092	September-98	98-53595	Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.	4
Omands	WQ1092	September-98	98-53595	Insecta	Diptera Chironomidae	<i>Polypedilum</i> sp.	1
Omands	WQ1092	September-98	98-53595	Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	1
Omands	WQ1092	September-98	98-53595	Insecta	Ephemeroptera	<i>Caenis</i> sp.	6
Omands	WQ1092	September-98	98-53595	Insecta	Odonata	<i>Enallagma</i> sp.	57
Omands	WQ1844	September-98	98-53596	Annelida	Hirudinea	<i>Dina</i> sp.	1
Omands	WQ1844	September-98	98-53596	Annelida	Hirudinea	<i>Glossiphonia complanata</i>	2
Omands	WQ1844	September-98	98-53596	Annelida	Hirudinea	<i>Helobdella stagnalis</i>	15
Omands	WQ1844	September-98	98-53596	Annelida	Hirudinea	<i>Nepheleopsis obscura</i>	4
Omands	WQ1844	September-98	98-53596	Arachnoidae	Hydracarina	<i>Arrenurus</i> sp.	1
Omands	WQ1844	September-98	98-53596	Arachnoidae	Hydracarina	Hydracarina unidentified	1
Omands	WQ1844	September-98	98-53596	Crustacea	Amphipoda	<i>Hyalella azteca</i>	5712
Omands	WQ1844	September-98	98-53596	Gastropoda	Pulmonata	<i>Physa</i> sp.	1
Omands	WQ1844	September-98	98-53596	Insecta	Coleoptera	<i>Halophilus</i> sp.	1
Omands	WQ1844	September-98	98-53596	Insecta	Coleoptera	<i>Hygroplitis</i> sp.	8
Omands	WQ1844	September-98	98-53596	Insecta	Coleoptera	<i>Laccophilus maculosus</i>	2
Omands	WQ1844	September-98	98-53596	Insecta	Diptera Chironomidae	<i>Ablabesmyia</i> sp.	2
Omands	WQ1844	September-98	98-53596	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	2
Omands	WQ1844	September-98	98-53596	Insecta	Diptera Chironomidae	<i>Einfeldia</i> sp.	2
Omands	WQ1844	September-98	98-53596	Insecta	Diptera Chironomidae	<i>Lauterborniella</i> sp.	2
Omands	WQ1844	September-98	98-53596	Insecta	Ephemeroptera	<i>Caenis</i> sp.	14
Omands	WQ1844	September-98	98-53596	Insecta	Hemiptera	<i>Sigara</i> sp.	1
Omands	WQ1844	September-98	98-53596	Insecta	Hemiptera	<i>Trichocorixa</i> naia	8
Omands	WQ1844	September-98	98-53596	Insecta	Odonata	<i>Enallagma</i> sp.	105
Sturgeon	WQ0775	September-97	97-61130	Annelida	Oligochaeta	<i>Nais</i> sp.	384
Sturgeon	WQ0775	September-97	97-61130	Annelida	Oligochaeta	<i>Stylaria lacustris</i>	3
Sturgeon	WQ0775	September-97	97-61130	Coelenterata	Coelenterata	<i>Hydra</i> sp.	3
Sturgeon	WQ0775	September-97	97-61130	Crustacea	Amphipoda	<i>Hyalella azteca</i>	3

Appendix 1. (continued).

Creek	Site	Date	Lab ID	Phylum or Order	Class or Subclass	Genus and species or Taxonomic Group	Total Number
Sturgeon	WQ0775	September-97	97-61130	Gastropoda	Ctenobranchiata	<i>Arnicola limosa</i>	2
Sturgeon	WQ0775	September-97	97-61130	Gastropoda	Pulmonata	<i>Ferrissia</i> sp.	6
Sturgeon	WQ0775	September-97	97-61130	Gastropoda	Pulmonata	<i>Physa</i> sp.	9
Sturgeon	WQ0775	September-97	97-61130	Insecta	Coleoptera	<i>Ochthebius</i> sp.	1
Sturgeon	WQ0775	September-97	97-61130	Insecta	Diptera Chironomidae	<i>Ablabesmyia</i> sp.	7
Sturgeon	WQ0775	September-97	97-61130	Insecta	Diptera Chironomidae	Chironomidae unidentified	2
Sturgeon	WQ0775	September-97	97-61130	Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	4
Sturgeon	WQ0775	September-97	97-61130	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	70
Sturgeon	WQ0775	September-97	97-61130	Insecta	Diptera Chironomidae	<i>Dicrotendipes</i> sp.	1
Sturgeon	WQ0775	September-97	97-61130	Insecta	Diptera Chironomidae	<i>Glyptotendipes</i> sp.	2
Sturgeon	WQ0775	September-97	97-61130	Insecta	Diptera Chironomidae	<i>Isociadius</i> sp.	41
Sturgeon	WQ0775	September-97	97-61130	Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	228
Sturgeon	WQ0775	September-97	97-61130	Insecta	Ephemeroptera	<i>Caenis</i> sp.	3
Sturgeon	WQ0775	September-97	97-61130	Insecta	Ephemeroptera	<i>Stenacron</i> sp.	9
Sturgeon	WQ0775	September-97	97-61130	Insecta	Trichoptera	<i>Cheumatopsyche</i> sp.	1
Sturgeon	WQ0775	September-97	97-61130	Insecta	Trichoptera	<i>Hydropsyche</i>	6
Sturgeon	WQ0775.01	September-97	97-61131	Annelida	Hirudinea	<i>Helobdella stagnalis</i>	1
Sturgeon	WQ0775.01	September-97	97-61131	Annelida	Oligochaeta	<i>Nais</i> sp.	16
Sturgeon	WQ0775.01	September-97	97-61131	Annelida	Oligochaeta	<i>Stylaria lacustris</i>	1
Sturgeon	WQ0775.01	September-97	97-61131	Crustacea	Amphipoda	<i>Hyalella azteca</i>	17
Sturgeon	WQ0775.01	September-97	97-61131	Gastropoda	Pulmonata	<i>Ferrissia</i> sp.	8
Sturgeon	WQ0775.01	September-97	97-61131	Gastropoda	Pulmonata	<i>Physa</i> sp.	25
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Coleoptera	<i>Gyrinus</i> sp.	1
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Coleoptera	<i>Liodessus affinis</i>	2
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Coleoptera	<i>Stenus</i> sp.	1
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Coleoptera	<i>Tropisternus</i> sp.	1
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Diptera Chironomidae	<i>Ablabesmyia</i> sp.	5
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Diptera Chironomidae	Chironomidae unidentified	9
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	4
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	8
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Diptera Chironomidae	<i>Dicrotendipes</i> sp.	6
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Diptera Chironomidae	<i>Glyptotendipes</i> sp.	12
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Diptera Chironomidae	<i>Isociadius</i> sp.	3
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Diptera Chironomidae	<i>Polypedilum</i> sp.	2
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	3
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Ephemeroptera	<i>Caenis</i> sp.	8
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Ephemeroptera	<i>Stenacron</i> sp.	3
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Hemiptera	<i>Sigara decoratella</i>	10
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Hemiptera	<i>Sigara</i> sp.	2
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Hemiptera	<i>Trichocorixa naia</i> s	49
Sturgeon	WQ0775.01	September-97	97-61131	Insecta	Odonata	<i>Enallagma</i> sp.	1
Sturgeon	WQ0776	September-97	97-61439	Annelida	Oligochaeta	<i>Nais</i> sp.	4
Sturgeon	WQ0776	September-97	97-61439	Annelida	Oligochaeta	<i>Pristina</i> sp.	1
Sturgeon	WQ0776	September-97	97-61439	Gastropoda	Ctenobranchiata	<i>Cincinnatia cincinnatiensis</i>	2
Sturgeon	WQ0776	September-97	97-61439	Gastropoda	Pulmonata	<i>Ferrissia</i> sp.	5
Sturgeon	WQ0776	September-97	97-61439	Insecta	Diptera Chironomidae	<i>Ablabesmyia</i> sp.	2
Sturgeon	WQ0776	September-97	97-61439	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	9
Sturgeon	WQ0776	September-97	97-61439	Insecta	Diptera Chironomidae	<i>Polypedilum</i> sp.	1
Sturgeon	WQ0776	September-97	97-61439	Insecta	Diptera Chironomidae	<i>Thienemannimyia</i> sp.	3
Sturgeon	WQ0776	September-97	97-61439	Insecta	Ephemeroptera	<i>Caenis</i> sp.	54
Sturgeon	WQ0776	September-97	97-61439	Insecta	Ephemeroptera	<i>Stenacron</i> sp.	13
Sturgeon	WQ0776	September-97	97-61439	Insecta	Hemiptera	<i>Hesperocorixa</i> sp.	11
Sturgeon	WQ0777	September-97	97-61440	Annelida	Oligochaeta	<i>Nais</i> sp.	2
Sturgeon	WQ0777	September-97	97-61440	Annelida	Oligochaeta	<i>Pristina</i> sp.	1
Sturgeon	WQ0777	September-97	97-61440	Gastropoda	Ctenobranchiata	<i>Cincinnatia cincinnatiensis</i>	1
Sturgeon	WQ0777	September-97	97-61440	Gastropoda	Ctenobranchiata	<i>Valvata tricarinata</i>	1
Sturgeon	WQ0777	September-97	97-61440	Gastropoda	Pulmonata	<i>Lymnaea</i> sp.	1
Sturgeon	WQ0777	September-97	97-61440	Gastropoda	Pulmonata	<i>Physa</i> sp.	1
Sturgeon	WQ0777	September-97	97-61440	Insecta	Coleoptera	<i>Dubiraphia</i> sp.	1
Sturgeon	WQ0777	September-97	97-61440	Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	3
Sturgeon	WQ0777	September-97	97-61440	Insecta	Diptera Chironomidae	<i>Cladotanytarsus</i> sp.	3
Sturgeon	WQ0777	September-97	97-61440	Insecta	Diptera Chironomidae	<i>Cryptochironomus</i> sp.	1
Sturgeon	WQ0777	September-97	97-61440	Insecta	Ephemeroptera	<i>Caenis</i> sp.	17
Sturgeon	WQ0777	September-97	97-61440	Insecta	Hemiptera	<i>Hesperocorixa</i> sp.	3
Sturgeon	WQ0777	September-97	97-61440	Insecta	Hemiptera	<i>Sigara decoratella</i>	3
Sturgeon	WQ0777	September-97	97-61440	Insecta	Hemiptera	<i>Sigara</i> sp.	1
Truro	WQ1042	September-98	98-53580	Annelida	Hirudinea	<i>Dina</i> sp.	1
Truro	WQ1042	September-98	98-53580	Annelida	Hirudinea	<i>Helobdella stagnalis</i>	1
Truro	WQ1042	September-98	98-53580	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	14
Truro	WQ1042	September-98	98-53580	Annelida	Oligochaeta	<i>Nais</i> sp.	1
Truro	WQ1042	September-98	98-53580	Annelida	Oligochaeta	<i>Tubifex</i> sp.	11
Truro	WQ1042	September-98	98-53580	Crustacea	Amphipoda	<i>Hyalella azteca</i>	13
Truro	WQ1042	September-98	98-53580	Gastropoda	Pulmonata	<i>Apelva hypnorum</i>	1
Truro	WQ1042	September-98	98-53580	Gastropoda	Pulmonata	<i>Physa</i> sp.	72
Truro	WQ1042	September-98	98-53580	Insecta	Diptera Chironomidae	<i>Procladius</i> sp.	4

Appendix 1. (continued).

Creek	Site	Date	Lab ID	Phylum or Order	Class or Subclass	Genus and species or Taxonomic Group	Total Number
Truro	WQ1042	September-98	98-53580	Insecta	Hemiptera	<i>Trichocorixa naiax</i>	1
Truro	WQ1042	September-98	98-53580	Insecta	Odonata	<i>Enallagma</i> sp.	3
Truro	WQ1045	September-98	98-53581	Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	2
Truro	WQ1045	September-98	98-53581	Gastropoda	Pulmonata	<i>Physa</i> sp.	1
Truro	WQ1045	September-98	98-53581	Insecta	Coleoptera	<i>Liodessus affinis</i>	2
Truro	WQ1045	September-98	98-53581	Insecta	Diptera Chironomidae	<i>Chironomus plumosus</i>	5
Truro	WQ1045	September-98	98-53581	Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	1
Truro	WQ1045	September-98	98-53581	Insecta	Hemiptera	<i>Notonecta</i> sp.	1

Appendix 2. Species list, tolerance values and quotients, and functional feeding group designations for macroinvertebrates collected from Bunn, S. Omand's, Sturgeon, and Truro Creeks in 1997 and 1998.

Phylum or Order	Order or Suborder	Genus and species or Group	Hilsenhoff ¹ Tolerance	Feeding ² Group 1	Feeding ² Group 2	Tolerance Quotients ³
Annelida	Hirudinea	<i>Dina</i> sp.	8	P		108
Annelida	Hirudinea	<i>Erpobdella punctata</i>	8	P		108
Annelida	Hirudinea	<i>Erpobdella</i> sp.	8	P		108
Annelida	Hirudinea	<i>Glossiphonia complanata</i>	8	P		108
Annelida	Hirudinea	<i>Helobdella stagnalis</i>	6	P		108
Annelida	Hirudinea	<i>Nepheleopsis obscura</i>	8	P		108
Annelida	Hirudinea	<i>Percymorensis marmoratus</i>	6	P		108
Annelida	Hirudinea	<i>Theromyzon maculosum</i>	2	CG		108
Annelida	Oligochaeta	<i>Dero</i> sp.	10	CG		108
Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	10	CG		108
Annelida	Oligochaeta	<i>Nais</i> sp.	8	CG		108
Annelida	Oligochaeta	<i>Paranais</i> sp.		CG		108
Annelida	Oligochaeta	<i>Pristina</i> sp.	8	CG		108
Annelida	Oligochaeta	<i>Stylaria lacustris</i>	8	CG		108
Annelida	Oligochaeta	<i>Stylodrilus heringianus</i>	8	CG		108
Annelida	Oligochaeta	<i>Tubifex</i> sp.	10	CG		108
Annelida	Oligochaeta	<i>Tubifex tubifex</i>	10	CG		108
Annelida	Oligochaeta	Tubificidae unidentified	10	CG		108
Arachnoidae	Hydracarina	<i>Arrenurus</i> sp.				108
Arachnoidae	Hydracarina	<i>Diplodontus</i> sp.				108
Arachnoidae	Hydracarina	<i>Eylais</i> sp.				108
Arachnoidae	Hydracarina	Hydracarina unidentified				108
Arachnoidae	Hydracarina	<i>Hydrachna</i> sp.				108
Arachnoidae	Hydracarina	<i>Hygrobatas</i> sp.				108
Arachnoidae	Hydracarina	<i>Limnesia</i> sp.				108
Arachnoidae	Hydracarina	<i>Piona</i> sp.				108
Coelenterata	Coelenterata	<i>Hydra</i> sp.	5	P		108
Crustacea	Amphipoda	<i>Hyalella azteca</i>	8	CG		108
Gastropoda	Ctenobranchiata	<i>Amnicola limosa</i>	8	SC		108
Gastropoda	Ctenobranchiata	<i>Cincinnati cincinnatiensis</i>	8	SC		108
Gastropoda	Ctenobranchiata	<i>Valvata</i> sp.	8	SC		108
Gastropoda	Ctenobranchiata	<i>Valvata tricarinata</i>	8	SC		108
Gastropoda	Pulmonata	<i>Aplexa hypnorum</i>	7	SC		108
Gastropoda	Pulmonata	<i>Ferrissia</i> sp.	6	SC		108
Gastropoda	Pulmonata	<i>Gyraulus</i> sp.	6	SC		108
Gastropoda	Pulmonata	<i>Helisoma</i> sp.	6	SC		108
Gastropoda	Pulmonata	<i>Lymnaea</i> sp.	6	SC		108
Gastropoda	Pulmonata	<i>Physa</i> sp.	8	SC		108
Gastropoda	Pulmonata	<i>Promenetus</i> sp.	6	SC		108
Insecta	Coleoptera	<i>Agabus</i> sp.	5	P		72
Insecta	Coleoptera	<i>Anacaena</i> sp.		P		72
Insecta	Coleoptera	<i>Berosus</i> sp.	5	CG	P	72
Insecta	Coleoptera	<i>Colymbetes</i> sp.	5	P		72
Insecta	Coleoptera	<i>Coptotomus</i> sp.	9	P		72
Insecta	Coleoptera	<i>Dubiraphia</i> sp.	6	SC		108
Insecta	Coleoptera	<i>Dytiscus</i> sp.	5	P		72
Insecta	Coleoptera	<i>Enochrus</i> sp.		PI	CG	72
Insecta	Coleoptera	<i>Graphoderus occidentalis</i>	5	P		72
Insecta	Coleoptera	<i>Gymnus</i> sp.	5	P		108
Insecta	Coleoptera	<i>Halplus borealis</i>	5	SH		54
Insecta	Coleoptera	<i>Halplus immaculicollis</i>	5	SH		54
Insecta	Coleoptera	<i>Halplus</i> sp.	5	SH		54
Insecta	Coleoptera	<i>Hydroporus</i> sp.	5	P	PI	72
Insecta	Coleoptera	<i>Hygrotus</i> sp.	5	P		72
Insecta	Coleoptera	<i>Hygrotus</i> sp.	5	P		72
Insecta	Coleoptera	<i>Laccophilus maculosus</i>	5	P		72
Insecta	Coleoptera	<i>Laccophilus</i> sp.	5	P		72
Insecta	Coleoptera	<i>Laccornis</i> sp.		P		72
Insecta	Coleoptera	<i>Liodessus affinis</i>	5	P		72
Insecta	Coleoptera	<i>Ochthebius</i> sp.		SC		72
Insecta	Coleoptera	<i>Paracymus</i> sp.		CG		72
Insecta	Coleoptera	<i>Peltodytes edentulus</i>	5	SH		54
Insecta	Coleoptera	<i>Peltodytes</i> sp.	5	SH		54
Insecta	Coleoptera	<i>Rhantus frontalis</i>	5	PI		72
Insecta	Coleoptera	<i>Rhantus</i> sp.	5	PI		72
Insecta	Coleoptera	<i>Stenus</i> sp.		P		108
Insecta	Coleoptera	<i>Tropisternus</i> sp.		CG	P	72
Insecta	Diptera Chironomidae	<i>Ablabesmyia</i> sp.	8	CG	P	108
Insecta	Diptera Chironomidae	Chironomidae unidentified		CG		108
Insecta	Diptera Chironomidae	<i>Chironomus plumosus</i>	10	SH	CG	108
Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	10	SH	CG	108

Appendix 2. Species list, tolerance values and quotients, and functional feeding group designations for macroinvertebrates collected from Bunn's, Omand's, Sturgeon, and Truro Creeks in 1997 and 1998 (continued).

Phylum or Order	Order or Suborder	Genus and species or Group	Hilsenhoff ¹ Tolerance	Feeding ² Group 1	Feeding ² Group 2	Tolerance Quotients ¹
Insecta	Diptera Chironomidae	<i>Cladotanytarsus</i> sp.	7	FC		108
Insecta	Diptera Chironomidae	<i>Corynoneura</i> sp.	7	CG		108
Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	4	CG		108
Insecta	Diptera Chironomidae	<i>Cryptochironomus</i> sp.	8	P		108
Insecta	Diptera Chironomidae	<i>Derolanytus</i> sp.	9	P		108
Insecta	Diptera Chironomidae	<i>Diamesa</i> sp.		CG		108
Insecta	Diptera Chironomidae	<i>Dicrotendipes</i> sp.	8	CG		108
Insecta	Diptera Chironomidae	<i>Einfeldia</i> sp.	9	CG		108
Insecta	Diptera Chironomidae	<i>Endochironomus</i> sp.	10	SH		108
Insecta	Diptera Chironomidae	<i>Fletchermyia</i> sp.		CG		108
Insecta	Diptera Chironomidae	<i>Glyptotendipes</i> sp.	10	FC	SH	108
Insecta	Diptera Chironomidae	<i>Isocladius</i> sp.		P		108
Insecta	Diptera Chironomidae	<i>Lauterborniella</i> sp.		CG		108
Insecta	Diptera Chironomidae	<i>Monodiamesa</i> sp.	7	CG		108
Insecta	Diptera Chironomidae	<i>Parachironomus</i> sp.	10	CG	P	108
Insecta	Diptera Chironomidae	<i>Paramerina</i> sp.	3	CG		108
Insecta	Diptera Chironomidae	<i>Paratanytarsus</i> sp.	7	CG		108
Insecta	Diptera Chironomidae	<i>Paratendipes</i> sp.	8	CG		108
Insecta	Diptera Chironomidae	<i>Polypedilum</i> sp.	6	SH		108
Insecta	Diptera Chironomidae	<i>Procladius</i> sp.	9	P		108
Insecta	Diptera Chironomidae	<i>Rheocricotopus</i> sp.	6	CG		108
Insecta	Diptera Chironomidae	<i>Tanytarsus</i> sp.	6	FC		108
Insecta	Diptera Chironomidae	<i>Thienemanniella</i> sp.	2	CG		108
Insecta	Diptera Chironomidae	<i>Palpomyia</i> sp.	6	P		108
Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	6	FC		108
Insecta	Ephemeroptera	<i>Baetis</i> sp.	6	CG		72
Insecta	Ephemeroptera	<i>Caenis</i> sp.	7	CG		72
Insecta	Ephemeroptera	<i>Calibaetis</i> sp.	9	CG		72
Insecta	Ephemeroptera	<i>Stenacron</i> sp.	4	SC		48
Insecta	Hemiptera	<i>Callinixa audeni</i>		P		108
Insecta	Hemiptera	<i>Corixidae</i> unidentified			PI	108
Insecta	Hemiptera	<i>Hesperocorixa</i> sp.	5	P	PI	108
Insecta	Hemiptera	<i>Mesovelia</i> sp.		P		72
Insecta	Hemiptera	<i>Notonecta</i> sp.		P		108
Insecta	Hemiptera	<i>Plea strolia</i>		P		108
Insecta	Hemiptera	<i>Saidula</i> sp.		P		72
Insecta	Hemiptera	<i>Sigara decoratella</i>		PI		108
Insecta	Hemiptera	<i>Sigara</i> sp.		PI		108
Insecta	Hemiptera	<i>Trichocorixa borealis</i>		P		108
Insecta	Hemiptera	<i>Trichocorixa naia</i> s		P		108
Insecta	Odonata	<i>Enallagma</i> sp.	8	P		72
Insecta	Odonata	<i>Ischnura</i> sp.	6	P		72
Insecta	Odonata	<i>Leucorrhinia</i> sp.	9	P		72
Insecta	Odonata	<i>Plathemis</i> sp.	3	P		72
Insecta	Odonata	<i>Stylurus</i> sp.	5	P		108
Insecta	Trichoptera	<i>Cheumatopsyche</i> sp.	5	FC		108
Insecta	Trichoptera	<i>Hydropsyche</i>	4	FC		108
Nematoda	Nematoda	Nematoda unidentified				108
Pelecypoda	Sphaeriidae	<i>Pisidium</i> sp.	8	FC		108

1. Tolerance values for use with HBI or Modified Hilsenhoff Biotic Index (Hilsenhoff, 1987) are based on tolerance values of individuals within a species using NYDEC or Hilsenhoff tolerance values where possible or alternately EPA values were identified using US EPA Macroinvertebrate Species List, Version 1 (May, 1994). Although a number of species, mainly within the Order Hemiptera, were not assigned tolerance values, Lenat values were not used as they are based on a different range.

2. Functional Feeding Groups were identified using US EPA Macroinvertebrate Species List, Version 1 (May, 1994) with additional information from Merritt and Cummins (1984). Feeding groups include: collector gatherers (CG), filter collectors (FC), predators (P), piercers (P), scrapers (SC), and shredders (SH).

Appendix 3. The Community Loss Index (Courtemanch and Davies 1987) compares taxa within a sample or composite sample to taxa in a reference sample. This table shows the mean database reference taken from Hughes (2000).

Phylum or Class	Order or Suborder	Genus and species or Group	Pooled Sample Average ¹
Crustacea	Amphipoda	<i>Hyalella azteca</i>	262
Insecta	Ephemeroptera	<i>Caenis</i> sp.	48
Crustacea	Amphipoda	<i>Gammarus</i> sp.	46
Insecta	Hemiptera	Corixidae unidentified	29
Gastropoda	Ctenobranchiata	<i>Amnicola limosa</i>	22
Pelecypoda	Sphaeriidae	<i>Sphaerium</i> sp.	15
Insecta	Diptera Chironomidae	<i>Chironomus</i> sp.	14
Insecta	Ephemeroptera	<i>Stenacron</i> sp.	12
Insecta	Ephemeroptera	<i>Baetis</i> sp.	10
Insecta	Ephemeroptera	<i>Leptophlebia</i> sp.	8
Insecta	Hemiptera	<i>Sigara</i> sp.	7
Insecta	Ephemeroptera	<i>Hexagenia</i> sp.	7
Insecta	Diptera Chironomidae	<i>Phaenopsectra</i> sp.	7
Gastropoda	Pulmonata	<i>Physa</i> sp.	7
Insecta	Diptera Chironomidae	<i>Procladius</i> sp.	6
Insecta	Odonata	<i>Enallagma</i> sp.	6
Insecta	Hemiptera	<i>Sigara lineata</i>	6
Insecta	Ephemeroptera	<i>Stenonema</i> sp.	5
Pelecypoda	Unionidae	<i>Anodonta grandis</i>	5
Insecta	Trichoptera	<i>Cheumatopsyche</i> sp.	5
Insecta	Diptera Chironomidae	<i>Dicortendipes</i> sp.	5
Insecta	Ephemeroptera	<i>Hexagenia limbata</i>	4
Insecta	Ephemeroptera	<i>Paraleptophlebia</i> sp.	4
Insecta	Coleoptera	<i>Dubiraphia</i> sp.	4
Insecta	Ephemeroptera	<i>Callibaetis</i> sp.	4
Pelecypoda	Sphaeriidae	<i>Psidium</i> sp.	3
Insecta	Trichoptera	<i>Hydropsyche</i> sp.	3
Insecta	Diptera Chironomidae	<i>Tanytarsus</i> sp.	3
Insecta	Hemiptera	<i>Hesperocorixa</i> sp.	3
Insecta	Diptera Miscellaneous	<i>Palpomyia</i> sp.	3
Insecta	Megaloptera	<i>Salix</i> sp.	2
Gastropoda	Pulmonata	<i>Ferrissia rivularis</i>	2
Insecta	Diptera Chironomidae	<i>Cricotopus</i> sp.	2
Insecta	Diptera Chironomidae	<i>Polypedium</i> sp.	2
Gastropoda	Pulmonata	<i>Ferrissia</i> sp.	2
Insecta	Diptera Chironomidae	Chironomidae unidentified	2
Insecta	Ephemeroptera	<i>Baetisca</i> sp.	2
Insecta	Trichoptera	<i>Neureclipsis</i> sp.	2
Annelida	Branchiobdellida	<i>Cambarincola</i> sp.	2
Gastropoda	Ctenobranchiata	<i>Cincinnati cincinnatiensis</i>	2
Insecta	Diptera Chironomidae	<i>Rhectanytarsus</i> sp.	2
Insecta	Ephemeroptera	<i>Ephemer</i> sp.	2
Gastropoda	Pulmonata	<i>Gyraulus</i> sp.	2
Insecta	Diptera Chironomidae	<i>Paratendipes</i> sp.	2
Insecta	Diptera Chironomidae	<i>Microtendipes</i> sp.	2
Insecta	Trichoptera	<i>Nectopsyche</i> sp.	2
Insecta	Diptera Chironomidae	<i>Ablabesmyia</i> sp.	2
Insecta	Diptera Miscellaneous	<i>Simulium</i> sp.	2
Insecta	Hemiptera	<i>Plea striola</i>	2
Insecta	Ephemeroptera	<i>Pseudocloeon</i> sp.	2
Insecta	Diptera Chironomidae	<i>Stictochironomus</i> sp.	2
Insecta	Coleoptera	<i>Optioservus</i> sp.	1
Insecta	Ephemeroptera	<i>Centroptilum</i> sp.	1
Insecta	Diptera Chironomidae	<i>Cryptotendipes</i> sp.	1
Insecta	Odonata	<i>Dromogomphus</i> sp.	1
Pelecypoda	Sphaeriidae	<i>Sphaerium simile</i>	1
Insecta	Hemiptera	<i>Callicorixa</i> sp.	1
Insecta	Diptera Chironomidae	<i>Paratanytarsus</i> sp.	1
Insecta	Diptera Chironomidae	<i>Stenochironomus</i> sp.	1
Insecta	Diptera Chironomidae	<i>Chironomus plumosus</i>	1
Annelida	Oligochaeta	<i>Tubifex</i> sp.	1
Annelida	Oligochaeta	<i>Limnodrilus</i> sp.	1
Insecta	Diptera Chironomidae	<i>Cladotanytarsus</i> sp.	1
Gastropoda	Ctenobranchiata	<i>Valvata tricarinata</i>	1
Insecta	Diptera Miscellaneous	<i>Atherix</i> sp.	1
Arachnoidea	Hydracarina	<i>Hydracarina unidentified</i>	1
Insecta	Diptera Chironomidae	<i>Endochironomus</i> sp.	1
Oligochaeta	Plesioptera	<i>Nais</i> sp.	1
Insecta	Hemiptera	<i>Trichocorixa borealis</i>	1
Insecta	Diptera Chironomidae	<i>Clinotanytus</i> sp.	1
Crustacea	Decapoda	<i>Oirconectes</i> sp.	1

Appendix 3. (Continued)

Phylum or Class	Order or Suborder	Genus and species or Group	Pooled Sample Average ¹
Insecta	Ephemeroptera	<i>Ephemera simulans</i>	1
Insecta	Diptera Miscellaneous	Diptera Miscellaneous unidentified	1
Insecta	Diptera Chironomidae	<i>Cryptochironomus</i> sp.	1
Annelida	Oligochaeta	<i>Paranais</i> sp.	1
Annelida	Oligochaeta	<i>Dero</i> sp.	1
Annelida	Oligochaeta	<i>Aelosoma</i> sp.	1
Insecta	Diptera Miscellaneous	<i>Hexatoma</i> sp.	1
Insecta	Coleoptera	<i>Stenelmis</i> sp.	1
Insecta	Diptera Miscellaneous	<i>Eriocera</i> sp.	1
Insecta	Coleoptera	<i>Halplus borealis</i>	1
Annelida	Hirudinea	<i>Dina</i> sp.	1
Insecta	Trichoptera	<i>Polycentropus</i> sp.	1

1. Mean numbers of organisms per taxa per pooled sample were calculated from the 1995 through 1998 rural stream data base. All mean values of less than 1 were excluded from the data base reference. The mean pooled sample size was 646 organisms while the urban creeks mean sample size was 625 organisms. Therefore the same size of reference sample used in Hughes (2000) was used for the urban creeks.

Appendix 4. Mean total alkalinity and sulphate used in estimating CTQp¹ for each site in 1997 and 1998 and explanation of the process for the derivation of CTQp.

Stream	Location	Site	Year	Mean Total Alkalinity (mg/L)	Mean Sulphate (mg/L)
Bunns Creek	at Springfield upstream of retention pond	WQ1919.00	1998	303	285
Bunns Creek	at Raleigh (NW side)	WQ1920.00	1998	303	196
Bunns Creek	at Bonner	WQ1922.00	1998	173	220
Omands Creek	at Omand's Park	WQ0866.00	1997	287	294
Omands Creek	at Omand's Park	WQ0866.00	1998	271	227
Omands Creek	at Portage Ave.	WQ1091.00	1997	275	301
Omands Creek	at Portage Ave.	WQ1091.00	1998	205	183
Omands Creek	at Ellice Ave.	WQ1092.00	1997	200	341
Omands Creek	at Ellice Ave.	WQ1092.00	1998	204	143
Omands Creek	at Entrance to Brookside Cemetary	WQ1093.00	1997	223	97
Omands Creek	at Entrance to Brookside Cemetary	WQ1093.00	1998	200	102
Omands Creek	at Orange and Dublin Ave.	WQ1844.00	1997	212	81
Omands Creek	at Orange and Dublin Ave.	WQ1844.00	1998	223	70
Omands Creek	at St. James and Dublin Ave.	WQ1845.00	1997	236	113
Sturgeon Creek	at Woodhaven Rd.	WQ0775.00	1997	294	280
Sturgeon Creek	at Hamilton Rd. bridge	WQ0776.00	1997	352	374
Sturgeon Creek	at Perimeter Hwy.	WQ0777.00	1997	378	356
Truro Creek	at Bruce Park downstream of bridge	WQ1042.00	1998	265	59
Truro Creek	downstream of Airport	WQ1045.00	1998	301	75

1. CTQp is the predicted Community Tolerance Quotient based on stream gradient, substrate, total alkalinity, and sulphate. The CTQp is compared with the mean of Tolerance Quotients for individuals within a taxon (CTQa) to derive the BCI or Biotic Condition Index (Winget and Mangum, 1979). A modified version of the Winget and Mangum key for the predicted Community Tolerance Quotients (CTQp) for streams examined in this report is shown in the following table.

	Key No.	CTQp
1. Stream Gradient (%) 0.1-1.2.....	2	
2. Substrate Mostly Gravel & Rubble.....	3	
Sand (or finer substrate) & Boulder, Rubble or Gravel.....	7	
3. Total Alkalinity (mg/L) 0-199.....	4	
200-300.....	5	
>300.....	6	
4. Sulphate (mg/L) 0-149.....		53
150-300.....		85
>300.....		103
5. Sulphate (mg/L) 0-149.....		55
150-300.....		86
>300.....		103
6. Sulphate (mg/L) 0-149.....		89
150-300.....		97
>300.....		108
7. Total Alkalinity (mg/L) 0-199.....	12	
200-300.....	13	
>300.....	14	
8. Sulphate (mg/L) 0-149.....		60
150-300.....		90
>300.....		108
9. Sulphate (mg/L) 0-149.....		60
150-300.....		90
>300.....		108
10. Sulphate (mg/L) 0-149.....		90
150-300.....		99
>300.....		108